United States Department of Agriculture
Forest Service

Hydrology

2017 Upper Briggs Restoration Project

Rogue River-Siskiyou National Forest,
Wild Rivers Ranger District

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Introduction

This report analyzes the hydrologic effects from proposed activities in the Upper Briggs Restoration Project.

Proposed activities meet objectives and comply with the standards and guidelines outlined in the Siskiyou National Forest Land and Resource Management Plan (USDA Forest Service 1989), as amended by the Northwest Forest Plan (USDA and USDI 1994). In addition to the Proposed Action (Alternative 2) and Alternative 3 described below, this analysis includes consideration of taking "No Action" (Alternative 1) which would be no treatment of any kind.

Proposed Action (Alternative 2) is to treat approximately 4017 acres of the Upper Briggs Creek watershed (HUC 6) to achieve the identified ecological need for each treatment unit. Silvicultural prescriptions and fuel treatments are tailored for each objective and described in more detail in the project silvicultural and fuels reports. These proposed objective treatments are also shown on Figure 1 as the following:

- Develop and Enhance Late Seral Habitat (DELSH)
- Restore Pine-Oak Communities
- Restore Sensitive Plant Habitat
- Restore Meadow Systems
- Restore Riparian Reserves
- Create and Maintain Strategically Located Fuel Management Zones (FMZ)
- Decrease Road Impacts to Watershed Function

Approximately 71% of proposed treatment acres are within stands that have had past harvest including clear cuts, salvage, shelterwood, seed tree, pre-commercial thinning, etc. The remaining unmanaged stands lack structural complexity due to fire exclusion starting in 1906 (Metlen et. al. 2016) which has resulted in dense ingrowth of shade tolerant Douglas-fir. Treatment of all stands would involve variable density thinning to reduce ingrowth and ladder fuels, increase species diversity and stand complexity and restore habitat features such as meadow, pine-oak woodlands and certain rare plant occurrences. Legacy trees greater than 120 years in age would be retained in treatment units.

Alternative 3 includes the same treatment objectives described Alternative 2, however the total area treated (2,628 acres) would only treat units that are under 80 years in stand age and implements a 120 foot no-treatment buffer on streams (Figure 2). Approximately, 0.61 miles of temporary road building would also occur under Alternative 3.

Figure 1: Alternative 2

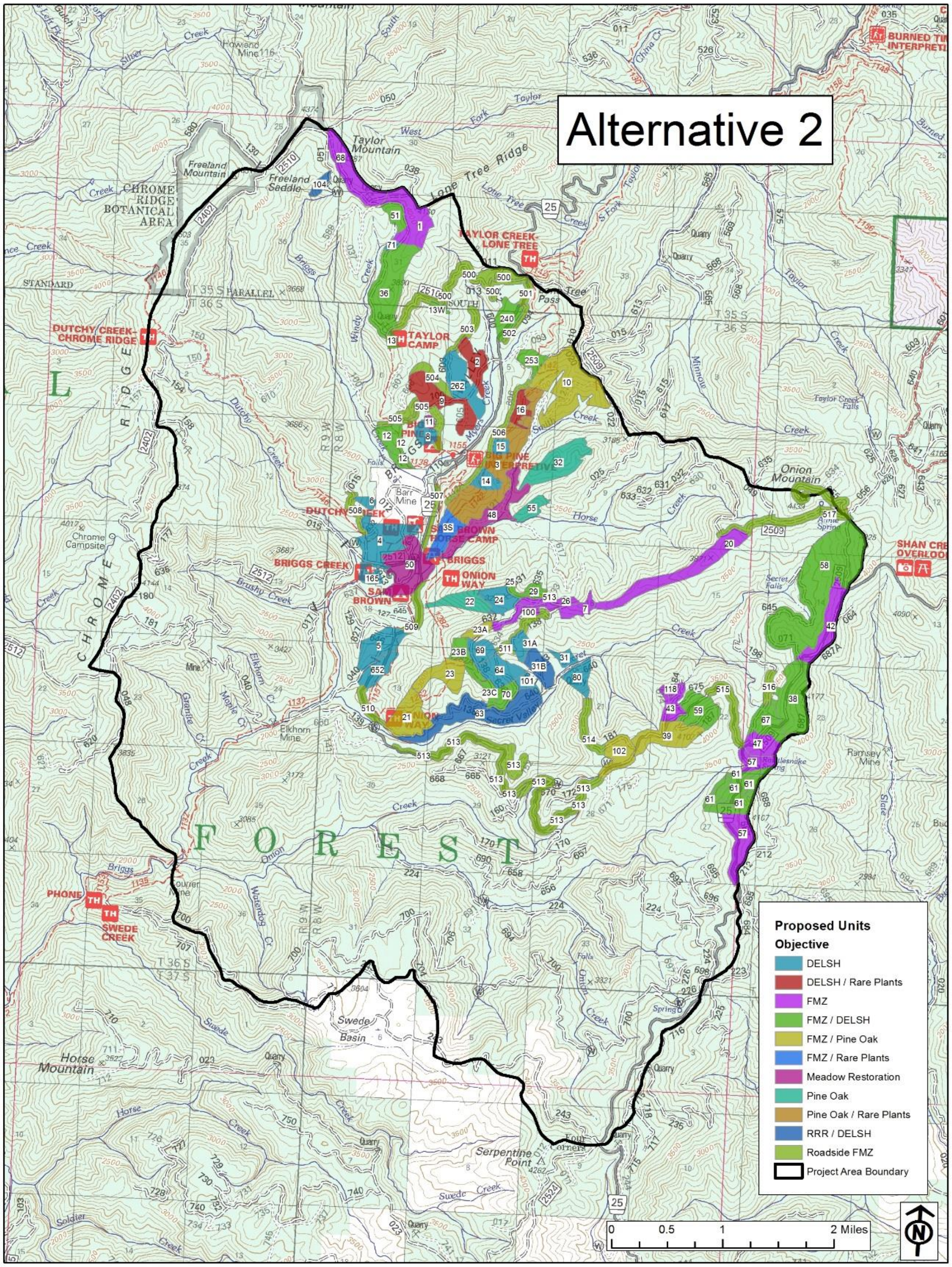
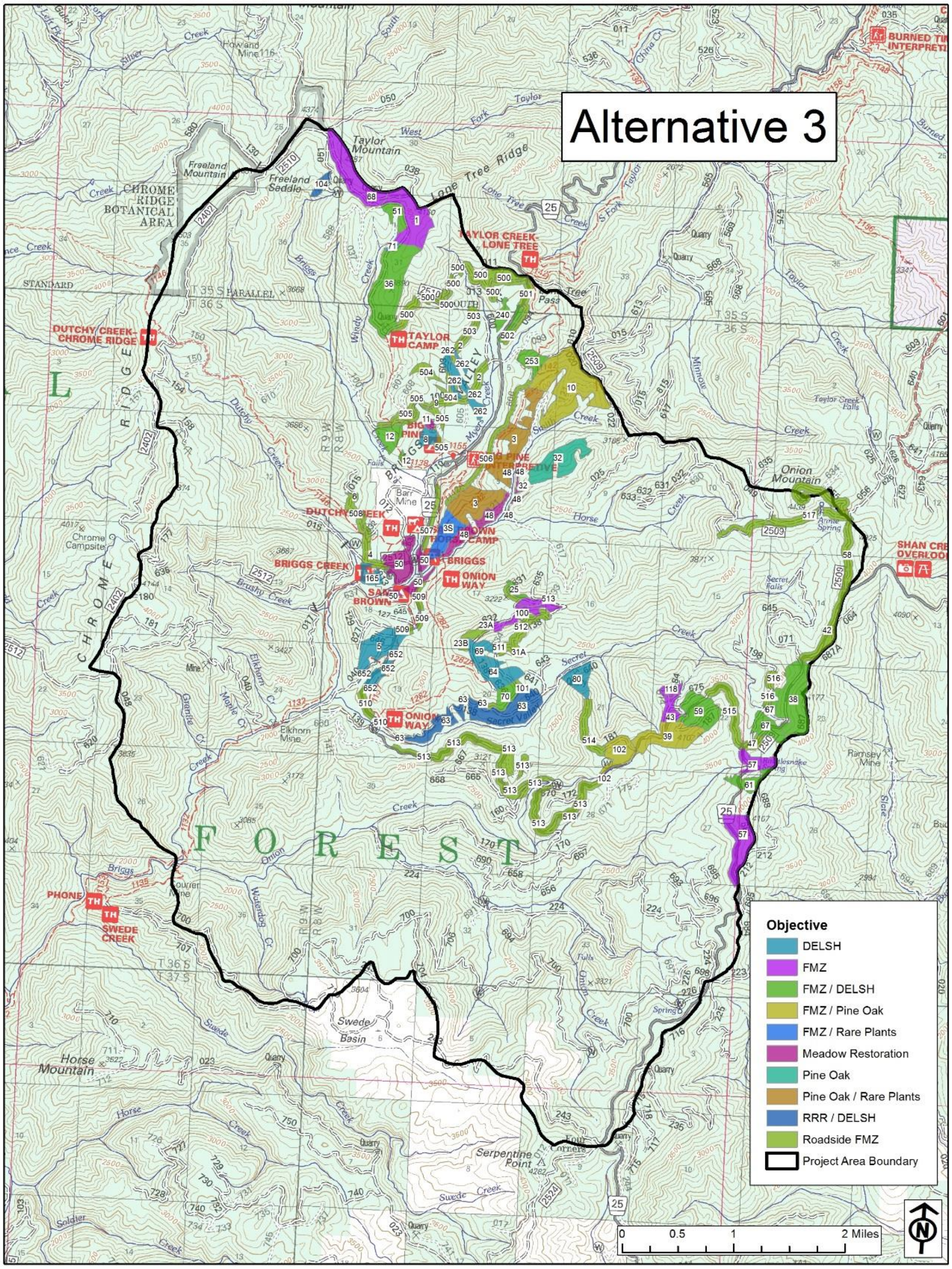


Figure 2: Alternative 3



Proposed Project Location

The Upper Briggs Project is located approximately eleven miles west of Grants Pass, Oregon in the Illinois River Sub-basin. The project boundary is the Upper Briggs Creek 6th level watershed (171003110701), entirely within the Briggs Creek 5th level watershed (1710031107). Briggs Creek is a major tributary and contributor to the water quality of the Wild and Scenic portion of the Illinois River. At the confluence of the Illinois River, Briggs Creek contributes approximately 10 to 20 percent of the total Illinois River flow. The main tributaries in the project boundary are Meyers, Brushy, Dutchy, Horse, Secret, and Onion Creeks (Figure 3).

Elevations ranges from 1720 feet at the confluence of Onion Creek and Briggs Creek to approximately 4,400 feet on both Taylor Mountain at the northwest boundary of the watershed and Onion Mountain on the southeast boundary.

Specialist Review Methodology

Spatial and Temporal Context for Effects Analysis

The boundary for hydrologic resource impacts is the 6th level HUC. The 6th HUC is used for hydrologic resources since water and erosional process move down channel and downslope.

When assessing potential impacts to hydrologic resources, short-term refers to 3-5 years or less while long-term refers to greater than 5 years.

Analysis Methods

This assessment of environmental consequences relies on relevant scientific literature, field observations, field survey data, monitoring data and observations from similar past projects, and professional judgment and experience. Analysis also includes notes, data collection, and data analysis from previous hydrologist(s). The techniques and methodologies used in this analysis consider the best available science.

Assumptions

This analysis assumes the conservative approach that *some form of treatment* will occur across all of the proposed treatment acres in each action alternative. Project design criteria and mitigation measures identified for this project ultimately limit this extent to a smaller area based on resource protection requirements and needs, as well as equipment and economic feasibility which can vary by equipment, methods, and timing (refer to the Logging and Transportation Report and Economic Analysis for the Upper Briggs project). However, through considering all acres in the proposed treatment units, this provides flexibility during implementation to be site specific during project layout to meet the resource objectives in the Upper Briggs purpose and need, while assuring effective protections to water resources.

The following analysis assumes that all relevant BMPs are applied to project activities.

Information Sources

Sources of information included the Watershed Condition Framework (WCF), literature review, watershed analysis, Stream Surveys, Forest GIS geodatabase. The 2012 Water Quality Report by the Oregon Department of Environmental Quality (ODEQ 2012) was used to determine if a stream was officially listed as having impaired water quality (denoted by placement on the 303(d) list).

SHADOW - RAPID model was utilized to create a stream network from a DEM. A “flow accumulation” of 20 acres was selected to identify the areas where streams originate. This information provided an estimate for the number of acres in Riparian Reserves (Park, C.S. 1993).

The data collected during stand exams by the Forest were entered into the Common Stand Exam database FSVeg and spatially linked in FSVeg Spatial. This data was then used to infer data to uncollected stands located within the project area boundary using a Nearest Neighbor imputation process in the FSVeg Spatial Data Analyzer. Total Stand Exam Plots Used in the Nearest Neighbor Analysis = 461 Collection plots were from 2008, 2011, 2015. Stand Examination plot data was used in the FSVeg Spatial Data Analyzer Nearest Neighbor imputation (see silvicultural specialist report).

Regulatory Framework

The following documents provide regulatory framework for resource management activities with respect to hydrology and establish applicable standards and guidelines. The potential effects to hydrologic resources from the proposed actions of this project are all compliant with the regulations listed below.

Land and Resource Management Plan

Direction for the management of the planning area comes primarily from the Standards and Guidelines of the Siskiyou National Forest LRMP (USDA Forest Service1989).

Siskiyou National Forest LRMP (USDA Forest Service 1989)

LRMP management *goals* related to hydrologic resources that are applicable to this project are to:

- Provide diverse, high quality water and fish habitat capable of maintaining or enhancing populations of game fish species with emphasis on anadromous fish habitat.
- Protect and enhanced identified, outstandingly remarkable values and free flowing condition of Wild and Scenic Rivers.
- Meet or exceed state and Federal requirements which provide protection to the air and water resources of the Forest.
- Provide water of sufficient quality and quantity for local and downstream beneficial uses.
- Maintain health and function of riparian ecosystems (including stream channel stability) for the protection or enhancement of riparian – dependent resources.

The *objectives* of the Siskiyou LRMP related to hydrologic resources that are applicable to this project are to:

- protect water quality and favorable conditions of flow through the application of Best Management Practices (BMPs)
- reduce stream temperatures by restoring and maintaining shade on stream surfaces
- monitor water quality and riparian condition by projects and by long-term trend analysis to document effects of plan implementation
- minimize contribution of sediment from soil-disturbing activities within the watershed through application of BMPs

Forest Service Manual 2520 R6 Supplement No. 2500-98-1 (Watershed Protection and Management)

The objectives of this supplement relative to water quality are: “To meet direction in the National Forest Management Act of 1976 and other legal mandates. To manage National Forest System lands under ecosystem management principles without permanent impairment of land productivity and to maintain or improve soil and water quality.”

Riparian Management Area LRMP (MA 11) and Aquatic Conservation Strategy NWP

The objective of MA 11 is to: “Protect intrinsic values of ecosystems bordering bodies of water and wetlands while providing limited multiple use development opportunities…applies to the riparian ecosystem along all perennial stream (Class I, II, and III). The minimum area of consideration is 100-ft measured horizontally from each side of the stream…” (USDA 1989). MA 11 was amended by the *Northwest Forest Plan* – which introduced the **Aquatic Conservation Strategy (ACS)**. ACS provided an increase in buffer widths of one to two site potential tree heights (150 feet and 300 feet, respectively) and its additional buffer of one site potential tree height for ephemeral channels.

The Siskiyou National Forest typically utilizes a standard site potential tree height of 150 feet for analysis purposes under the ACS. For the Upper Briggs Creek project, a site potential tree height of 180 feet will be used for analysis purposes. For the project area, a stream network was generated from a digital elevation model. A mapped perennial channel is initiated when a collection area reaches 20 acres.

ACS was developed to restore and maintain the ecological health of watersheds and aquatic ecosystems and included the following four components: (1) riparian reserves, (2) key watersheds, (3) watershed analysis, and (4) watershed restoration components (USDA and USDI 1994). The ACS is guided by nine objectives which are meant to focus agency actions to protect ecological processes at the 5th-field hydrologic scale, or watershed, at the 6th and or 7th fields (subwatershed and or drainage), and at the site level.

Riparian Reserves designated initial protective buffer widths and specific management requirements to maintain and restore riparian structures and functions for permanent, seasonal, and intermittent streams, wetlands, ponds and lakes. They were meant to confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and dispersal corridors for many terrestrial animals and plants, and provide for greater connectivity of the watershed (USDA and USDI 1994). There are approximately 6,714 acres of Riparian Reserves in the Upper Briggs Creek Project area (Figure 4).

Key Watersheds were designated as Tier 1, Tier 2, or non-key Watersheds and were meant to overlay all allocations and have additional standards and guidelines in order to provide protection for at-risk fish species and stocks and to identify those where high water quality is important (USDA and USDI 1994)

Watershed analysis for key watersheds and roadless areas, along with watershed restoration would then be conducted to inform and refine reserve boundaries, land management requirements, restoration actions, and monitoring activities. High priorities would be watershed restoration and reducing road mileage (USDA and USDI 1994).

The Upper Briggs Creek Project Area is considered a non-key watershed. The watershed analysis pertinent to the project planning area are: *The Briggs Creek Watershed Analysis Version 1* (USDA 1997).

Figure 3: Upper Briggs Creek Project Area

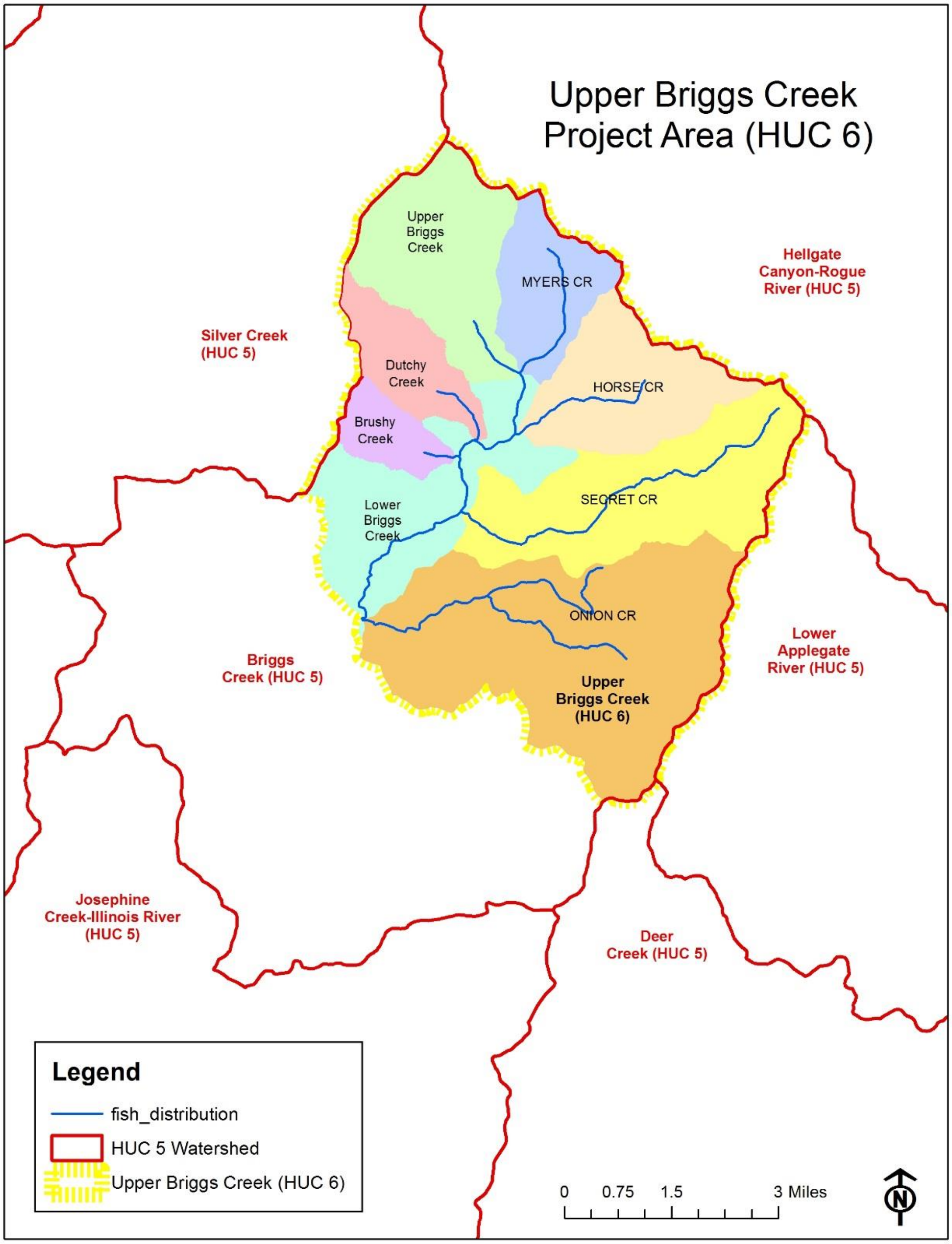
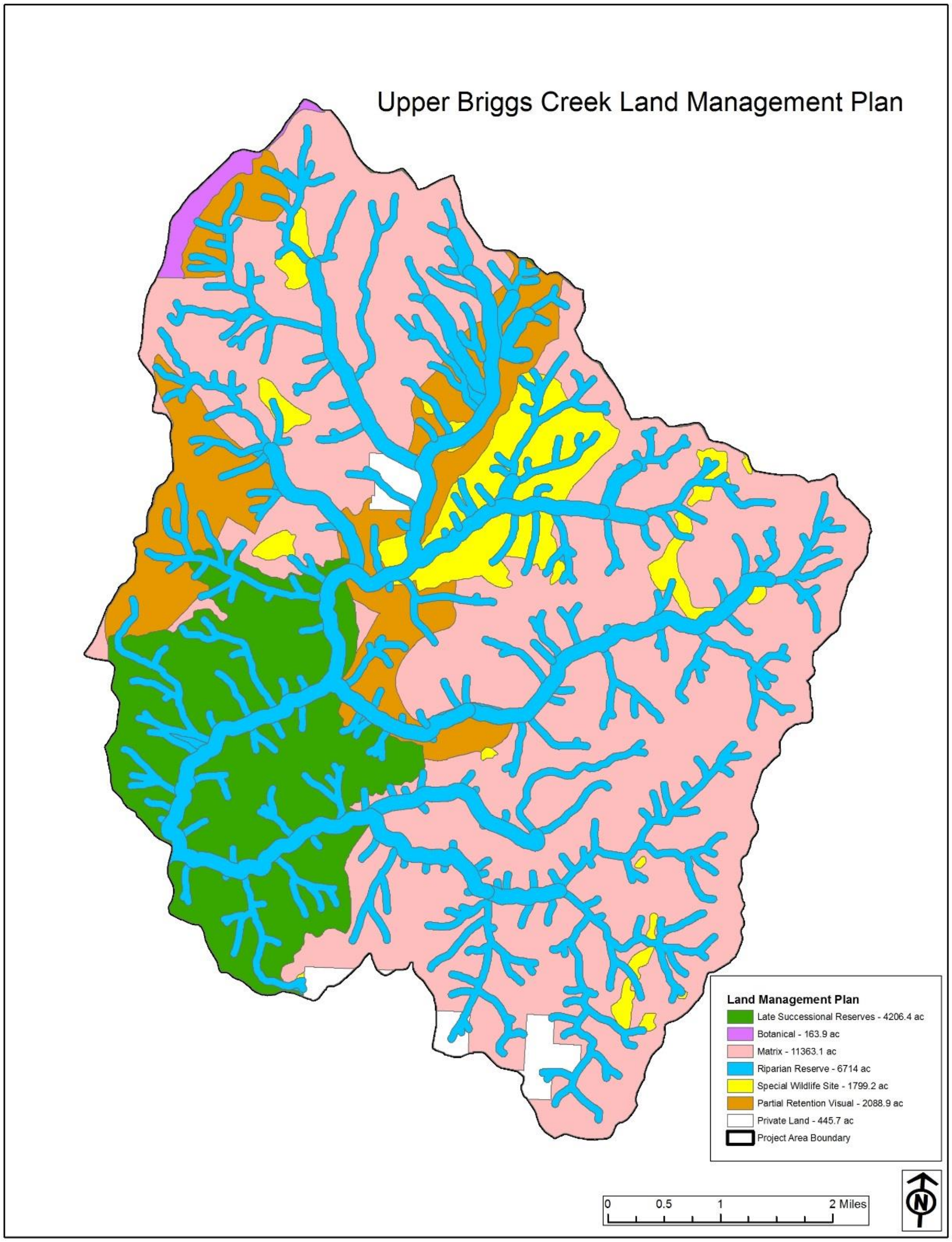


Figure 4: Upper Briggs Creek Land Management Plan



The Clean Water Act (1972) and Sections 319 and 303(d)

The primary objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of all waters to protect the 'beneficial uses' as documented according to criteria by the Oregon Department of Environmental Quality (ODEQ). A beneficial use is a resource or activity that would be directly affected by a change in water quality or quantity. Beneficial uses are defined on a basin scale in the Oregon Administrative Rules for water quality and cover large areas of land. The beneficial use for surface water in the analysis area include domestic use and drinking water, stock watering, irrigation, industrial water supply, fish habitat, wildlife habitat, recreation, aesthetics and commercial navigation and transportation (ODEQ 2012). Minimum state water quality standards have been established by the Oregon Department of Environmental Quality (ODEQ) in accordance with these beneficial uses. Briggs Creek was listed as impaired for temperature on the 2004 ODEQ 303(d) list (ODEQ 2004). A Water Quality Management Plan (WQMP) was completed for the Rogue River. In this plan, the Oregon Department of Environmental Quality established a Total Maximum Daily Load (TMDL) for stream temperature (Crown et al. 2008). This plan established a strategy for maintaining existing stream temperature. Based on the WQMP and TMDL, Briggs Creek was removed from the 303(d) list in 2010.

Under Section 319 of the 1987 CWA Amendments, States are required to determine those waters that will not meet the goals of the CWA, determine those non-point source activities that are contributing pollution, and develop a process on how to reduce such pollution to the "maximum extent practicable." Section 303(d) of the CWA requires that a list be developed of all impaired or threatened waters within each state. The ODEQ is responsible for compiling the 303(d) list, assessing data, and submitting the 303(d) list to the Environmental Protection Agency (EPA) for federal approval. The 303(d) list identifies waters where water quality standards are not met and where pollutant load limits (Total Maximum Daily Loads) are needed.

Executive Orders

The following Executive Orders pertain to this project:

- Executive Order 12088 requires Federal compliance with pollution control standards (i.e. the Clean Water Act).
- Executive Order 11988 requires agencies to avoid adverse impacts associated with the occupancy and modification of floodplains.
- Executive Order 11990 requires agencies to avoid adverse impacts associated with the destruction or modification of wetlands.

Watershed Condition Framework (U.S. Forest Service Watershed Condition Classification Technical Guide, 2010)

In 2010 all watersheds within the Forest were analyzed using the Watershed Condition Framework process (USFS 2010a). This analysis found Upper Briggs Creek watershed to be in condition class 1, or properly functioning.

Best Management Practices/Mitigation Measures/Project Design Criteria

National Best Management Practices for Water Quality Management on National Forest System Lands (April 2012)

This document was developed to improve agency performance and accountability in managing water quality consistent with the Federal Clean Water Act (CWS) and State water quality programs. Current Forest Service policy directs compliance with required CWA permits and state regulations and requires the use of BMPs to control nonpoint source pollution to meet applicable water quality standards and other CWA requirements.

Mitigation Measures designed for the protection of water quality are generally referred to as Best Management Practices (BMPs) as described in *General Water Quality Best Management Practices*, Pacific Northwest Region, November 1988 (USDA 1988), in concert with the National Core BMP Technical Guide (USDA 2012). While the terminology in the 1988 BMPs is dated (for example Streamside Management Unit now falls under Riparian Reserve), they are still considered effective under today's management direction.

A combination of Best Management Practices, mitigation measures and project design criteria are required to ensure compliance with the regulatory framework for water resources and/or to reduce the risk of adverse impacts to water resources (Appendix A and B).

Affected Environment

Existing Conditions

The Upper Briggs Project is located approximately eleven miles west of Grants Pass, Oregon in the Illinois River Sub-basin. The project area is the entire Upper Briggs Creek 6th field watershed (171003110701), entirely within the Briggs Creek 5th field watershed (1710031107) as shown in Figure 3. Briggs Creek is a major tributary and contributor to the water quality of the Wild and Scenic portion of the Illinois River. At the confluence of the Illinois River, Briggs Creek contributes approximately 10 to 20 percent of the total Illinois River flow. The main tributaries in the project boundary are Meyers, Brushy, Dutchy, Horse, Secret, and Onion Creeks (Figure 3). Table 1 lists the proposed treatment acres by subwatershed.

Elevations ranges from ~1,720 feet at the confluence of Onion Creek and Briggs Creek to approximately 4,400 feet on both Taylor Mountain at the northwest boundary of the watershed and Onion Mountain on the southeast boundary.

The Upper Briggs Creek watershed is approximately 24,645 acres of which less than 2% (446 acres) is privately owned and the rest is managed by the Rogue River-Siskiyou NF. Approximately 20% of National Forest lands are managed stands with past timber harvest including plantations ranging from 20 to 67 years in age.

Table 1: Acres by Subwatershed (Alternative 2)

6th field Project Area Watershed	Acres	Acres proposed treatments	% in Watershed
Upper Briggs Creek (171003110701)	24,645	4,017	16 %
Subwatershed	Acres	Acres of proposed treatments	% in subwatershed
Dutchy Creek	1,360	25	1.8 %
Brushy Creek	804	0	0
Horse Creek	2,643	728	27.5 %
Upper Briggs Creek	3,020	304	10.0 %
Lower Briggs Creek	3,234	340	10.5 %
Meyers Creek	1,719	610	35.4 %
Onion Creek	7,547	317	4.2 %
Secret Creek	4,323	1,693	39.2 %

Climate

The climate is characterized by moist and cool winter with warm and dry summers. Normal rainfall for the Upper Briggs Creek Watershed is 50 – 90 inches per year for precipitation (Taylor, 1994). Most of the precipitation is predominately rain- dominated (between November and March) but can be subject to rain-on-snow events in elevations greater than 2500 feet. Shallow soils are common which can lead to rapid runoff and high flows during winter storms and low flows during the summer dry period.

Briggs Valley

Briggs Valley is a unique hydrologic feature for this watershed. It is the largest (approximately 1100 acres) moderately high (2200 feet above sea level in elevation) alluvial valley on the district. Briggs Valley soils are deep loams with shallow silty sands and slate-like shale that are underlain by amphibole gneiss faulted against Galice formation. Secret Valley (in Secret Creek sub-watershed) and Horse Meadows (in Horse Creek sub-watershed) share similar alluvial characteristics. Several sub-watersheds come together in the valley (Horse, Dutchy, Brushy, and Meyers). They contribute cooler summer water temperatures ranging in the low 60's (degree F).

Prehistorically, Briggs Valley was likely an intermittent wetland with a series of beaver dams, narrow and sinuous side channels with oxbow lakes, feeding a braided, slightly entrenched main channel that occasionally changed course with flooding events. Large wood was likely very common and scattered on the flood plains of this marshy valley. Scattered remains of dry braided channels and wetland vegetation were commonly found in the currently dry grassy meadows of the valley prior to 1987. The meadows were used as massive staging areas for the Silver Fire (1987) and were deep ripped and planted with grass seed in an effort to reclaim the site after fire crews and equipment left the area somewhat compacted. It is expected that the earlier homesteads, placer mining, and Ferrin Guard Station were primarily responsible for the current general conditions. These efforts included confining of channels, draining of fertile lands for planting of fruit trees and gardens, and for building sites, diversions of water, displacement of high bank and instream materials for gold recovery, and trapping of keystone wetland species (beaver). Timber harvest in the valley (approximately 600 acres with another 200 acres in the adjacent Secret Valley), and campground development and maintenance have added to the reduced rate of riparian productivity in the valley. The current condition, although very different from historic conditions, is a more stable condition with regards to channel morphology. It is unknown how this more stable and confined channel has affected the productivity of riparian area in the valley.

Briggs Creek

Briggs Creek is low gradient, cobble and gravel dominated stream that flows through narrow colluvial canyons, bedrock gorges, flat-floored alluviated canyons, and wide alluvial valleys. The riparian forests were varied in seral stage, species composition, and density but generally were found to be dominated by a Douglas fir and Port Orford cedar overstory and a bigleaf maple, alder, vine maple understory. Other notable species include ponderosa pine, madrone, canyon live oak, tanoak, willow, and growing abundantly within the wetted channel in many areas coltsfoot. The Biscuit Fire of 2002 did not adversely affect the riparian forests of Briggs Creek. Briggs Creek is predominately a pool dominated stream (SRG, 2003).

The stream velocity of Briggs Creek is moderately high. This can be attributed to a fairly large drainage area of 24,645 (HUC 6), 50-90 inches of rainfall and moderate relief. Winter stream flows within the semi-entrenched channel and valley bottoms are sufficient for moving bedload sediment throughout the system and maintaining an equilibrium between current sediment supply and transport. Streamflow recedes rapidly following storms in

Briggs Creek. When there is no or little rainfall over a 100 day period, the flow can drop more than 90% (Hansen, 1976). Low summer flows, especially during drought years, can be a limiting factor for riparian productivity (USDA Forest Service, 1997).

Meyers Creek

Meyers Creek contributes approximately 15% flow to Briggs Creek (SRG, 2003). Meyers Creek's confluence is located 12 miles above the mouth of Briggs Creek. It flows south-westerly in orientation and has a 1719 acre drainage area with 672 acres in riparian reserve. The percent of perennial reserves affected by management (82%) and miles of road per square mile is also the highest in the sub-watershed. Seral stage distribution indicates that Meyers Creek riparian reserves would benefit from pre-commercial thinning and road obliteration.

Meyers Creek has a moderately entrenched channel and the lower mainstem flows through an alluvial valley with a 1% average gradient in the lower 1½ miles. Beaver were documented as late as 1973 in this area and had considerable effects on the channel and water quality. Above this point the valley narrows and the stream becomes a more confined colluvial canyon as the gradient steepens and the stream becomes more entrenched. Riparian vegetation has been affected by campground maintenance and trail construction although the effects are not significant to riparian function. Hydrologic stream function has been altered significantly but only locally and due to the blasting of bedrock to create pools and the cabling of instream log structures. These structures tend to create a more confined and entrenched channel.

The confluence of Meyers and Briggs Creek is on private land (patented placer mining claim). There is a lack of hydrologic data in this area.

Secret Creek

Secret Creek contributes approximately 30% flow to Briggs Creek (SRG, 2003). Secret Creek's confluence is located 9.5 miles above the mouth of Briggs Creek. It flows southwest in orientation and has 4327 acres of drainage area. Approximately 1086 acres are located in riparian reserve.

There has been a history of previous harvest and road building in Secret Creek. The channel's moderately entrenched main stem meanders through the center of the valley; side slopes average 30%. The upper main stem above the valley is moderately to deeply entrenched in a colluvial and bedrock canyon. Average stream gradient is 1.5 to 4% in the lower reaches and 7 to 15% in the upper reaches. Stream surveys classify these channels as Rosgen B3, alluvially-formed channels with moderate entrenchment and bed sediments composed of gravel and cobble. Surveyors also found that banks are relatively stable. The width to depth ratio is 25 suggesting it is slightly wider and shallower than what would be expected for this type of channel. The channel is in a state of recovery from an aggraded condition related to past timber harvest and road construction. Riparian productivity is lower than historic conditions and the potential for recovery is very good. GIS data indicates that recovery, from management in localized riparian reserves are unbalanced with greater than average perennial riparian area in early seral stage. This suggests that there are pre-commercial thinning and road obliteration opportunities in these reserves that would encourage mid-late seral vegetation development.

Horse Creek

Horse Creek is a small tributary contributing approximately 5% flow to Briggs Creek (SRG, 2003). The lower portions have a very low gradient and meander through Horse Creek Meadow. This meadow is currently the largest meadow in the watershed that has been routinely treated for brush encroachment through brush-cutting and prescribed fire. The south-facing slope on the northwest side of the meadow has a large component of California black oak that is now encroached with small Douglas-fir due to decades of fire exclusion. Additional meadow areas around Sam Brown Campground are in need of encroachment treatments. Historic air photos from 1940 show more extensive meadows than what currently exist in the watershed. At one time an old homestead existed in Horse Creek Meadows. Approximately 190 acres of the proposed treatment units include these historic meadow areas.

Horse Creek's confluence is located 11.3 miles above the mouth of Briggs Creek with a drainage area of 2648 acres and approximately 770 acres in riparian reserves. Lower Horse Creek is in an alluvial valley with a moderately entrenched channel (1.5% gradient). Historically, beaver had major effects on the morphology of Horse Creek. Side channels and ponding in the valley would have occurred, localized deposits of large wood and sediments would have accumulated. More plentiful summer flows with slightly warmer summer water temperatures would have been associated with those conditions. This stream is still experiencing some cutting as it has been generally confined to its present location (removal of beavers, draining of wet lands and re-routing of stream for homestead, agriculture, and road construction). The lower channel could revert back to its historic more complex condition if beaver are reintroduced. Two miles upstream the valley width begins to narrow, the gradient increases (3-6%) and changes to a more incised and entrenched channel in a colluvial canyon. Banks are more stable, and canopy cover averages 60%.

GIS data indicates that recovery is unbalanced with greater than 60% of the perennial riparian area in early seral stage indicating pre-commercial thinning and road obliteration opportunities in these reserves would encourage mid-late seral vegetation development.

Dutchy Creek

Dutchy Creek contributes approximately 45% flow to Briggs Creek (SRG, 2003).The Dutchy Creek watershed is 1360 acres in size. Approximately 364 acres are in riparian reserve.

Brushy Creek

Brushy Creek contributes approximately 10% flow to Briggs Creek (SRG, 2003).The Brushy Creek watershed is 804 acres in size with approximately 192 acres in riparian reserve.

Onion Creek

Onion Creek contributes approximately 30% flow to Briggs Creek (SRG, 2003).
The Onion Creek watershed is 7,547 acres in size with approximately 1926 acres in riparian reserves. Braided channels are common on Onion Creek. Stream banks are generally stable and well armored by riparian vegetation. The channel substrate ranges in combination of bedrock, boulder, cobbles and some areas of sand. In areas the channel lacks structure from large wood. Overall past timber harvest has reduced large wood recruitment by 17%. The width to depth ratio is 27, suggesting it is wider and shallower than what would be expected for this type of channel.

There has been a history of previous harvest and road building in Onion Creek. The stream is in a state of recovery with no new sediment sources evident.

Channel Morphology

The Upper Briggs Creek watershed is characterized by moderately entrenched streams in narrow to broad canyon valleys with moderate to steep slopes in association with terraces. Stream width and channel alignment in the main stem, are limited by inner alluvial canyons with occasional very wide alluvial valley bottoms. Briggs Valley is the largest (approximately 1100 acres) alluvial valley on the district and is a unique feature to the watershed. There are approximately 141 miles of perennial streams in the watershed. Approximately 27% of the watershed is in riparian reserves. Of this, management has affected nearly 16% of the riparian reserve acres.

Timber harvest, mining, and roads can increase sediment production, and reduce instream large wood, which can cause changes in channel morphology. Sediment from harvest units is delivered to a stream by either slope failure or surface erosion (see section on sediment). Roads deliver sediment when water is forced on or across a road by a failed drainage system. Culverts plugging is the single largest source of sediment delivered to streams (USDA 1998a). Large wood plays an important role in pool formation in the upper main stem and tributaries.

Roads

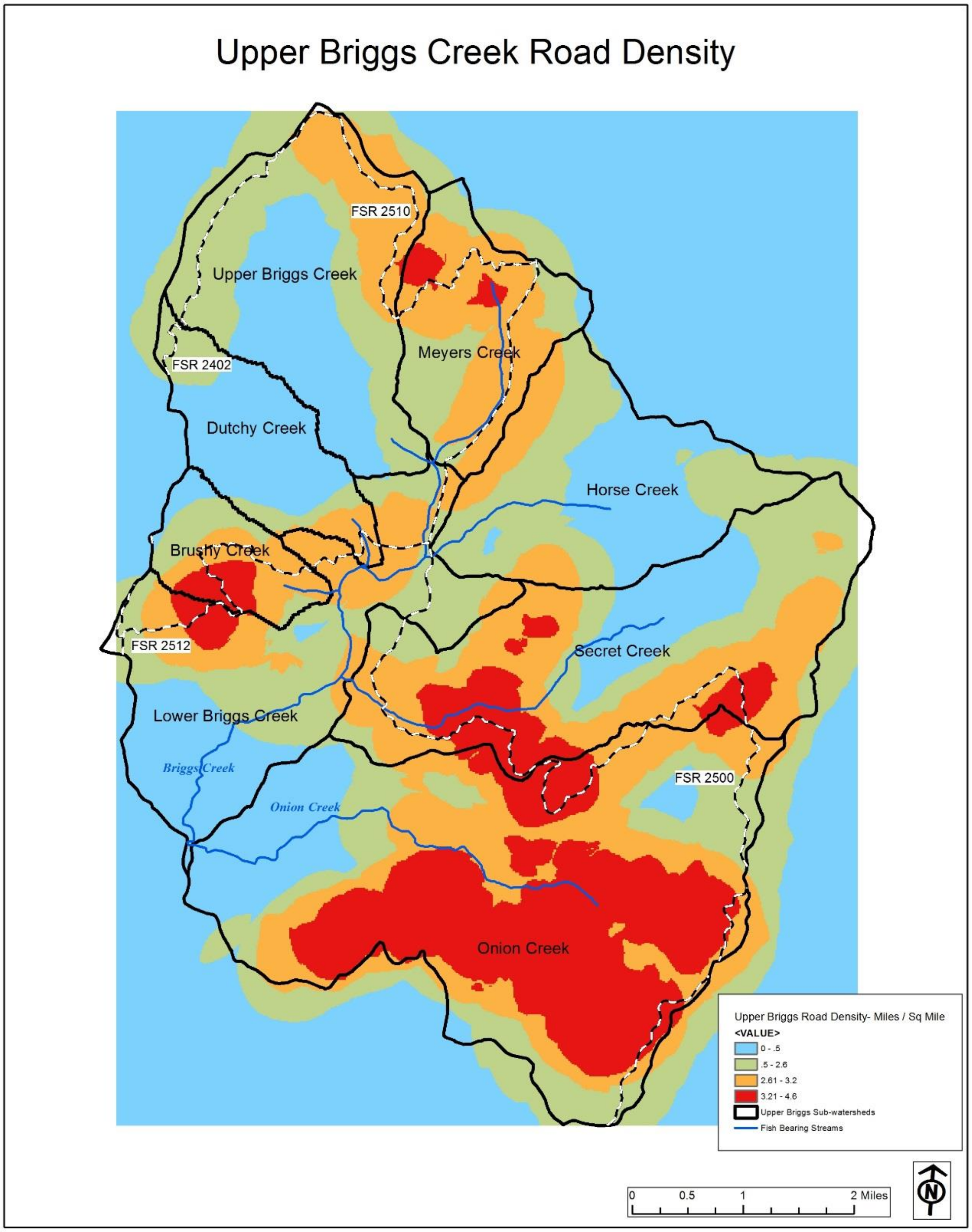
Watershed slope influences the potential for groundwater interception and redistribution of flows. Watershed relief is determined by calculating the difference in elevation between the highest and lowest points of the basin divided by the length of the basin in a line approximately parallel to the major drainage. There are approximately 120 miles of FS system roads with a minimum of 29 miles of system roads located within perennial riparian reserves. Road density for the entire Upper Briggs Creek Watershed is 3.13 miles/sq. mile (Table 2; Figure 5).

Watershed risk can be evaluated by assessing road density relative to overall watershed relief. Road density less than 3.0 miles per square mile is considered low risk for channel network expansion sufficient to increase peak flows; 3.0 to 5.0 miles per square mile is considered moderate risk; over 5.0 miles per square mile is considered high risk for contribution to increased peak flow (USDA 1993). The project area is mostly in the low watershed risk category.

Table 2: Forest Service system roads in the Upper Briggs Project

Subwatershed Name	Square Miles	Road Miles	Density (mi/sq mi)	Risk *
Brushy Creek	1.26	3.3	2.62	low
Dutchy Creek	2.14	3.7	1.73	low
Horse Creek	4.13	10.8	2.62	low
Lower Briggs Creek	5.06	14.5	2.87	low
Myers Creek	2.7	12.3	4.56	moderate
Upper Briggs Creek	4.71	11.2	2.38	low
Onion Creek	11.8	40.11	3.40	moderate
Secret Creek	6.8	24.8	3.65	moderate
Total (Project Area)	38.6	120.71	3.13	~ Low

Figure 5: Upper Briggs Creek Road Density



Stream Temperature
Stream flow and vegetative and topographic shade primarily influence localized summer stream water temperatures. The slightly higher temperatures in Briggs Creek seen today can be attributed

to alteration of riparian vegetation due to management and natural catastrophe, primarily storm event flooding, in this watershed. Recorded temperature increases can also be attributed to lower flows and hotter drier summers during the last drought from which most of the current data have been collected. Drought low flows during 1992 were less than half the amount recorded at same locations in 1993 (average rain year) in this watershed. Increases in stream temperatures during 1992 were associated with the drought low flows. At the mouth of Briggs Creek, the current condition for the range of summer 7 day average high stream temperature is 65-69 degrees F. Horse, Dutchy, Brushy, and Meyers Creek come together in the project area of Briggs Valley and contribute significantly cooler waters ranging in the low 60's (degree F).

Roads built parallel to the stream channels within the riparian zones, timber harvesting adjacent to perennial streams, and past placer mining and homesteading are the main management related activities contributing to inadequate shading throughout this watershed. There may be a higher than normal abundance of fuels especially in the headwater areas of this watershed. A catastrophic fire, disease, or insect epidemic, in a sub-watershed could reduce riparian shade and indirectly cause temporary summer water temperature increases. Management activities, which could lower summer stream temperatures would include riparian silviculture, the promotion of a diverse vegetation with large diameter trees, and reduction of potentially catastrophic fuel levels, with the goal of providing denser long term riparian shade.

Water Quality

The lower 16 miles of the main stem of Briggs Creek was considered water quality limited by the Oregon Department of Environmental Quality (ODEQ) and placed on the 303(d) list in 1998 for summer stream temperature. In 2003, a Total Maximum Daily Load (TMDL) and associated Water Quality Management Plan (WQMP) was developed. The WQMP includes a strategy for implementing and achieving the TMDL and identifies the “designated management agencies” (DMAs). The Forest Service is one of the DMAs and is responsible for land uses on Forest Service-managed land addressed in the NWFP, associated Aquatic Conservation Strategy, and WQMP for the Illinois Basin. In 2008, the TMDL and WQMP were approved by EPA and the streams were de-listed in 2010.

Sedimentation

Sediment delivered to a stream channel may be transported or stored, depending on the amount, particle size, and timing of the input. The transportation of coarse materials by the stream changes channel equilibrium through aggradation or degradation processes. Increased sediment input may cause channel widening, abrading, storage of sediment on floodplains, in gravel bars, and within the channel causing decreased pool area (see section on channel morphology). Road building and timber harvest has been agents that have had impacts on timing and spatial extent on sediment delivery.

Soil materials are transported from hillslopes to streams channels chiefly by mass failure. Mass failure results if the shear stress acting on the material exceeds the available shear strength of that material (Swanston, 1974). Plant roots can help stabilize slopes by anchoring a weak soil mass to fractures in bedrock, by crossing zones of weakness to more stable soil, and by providing long fibrous binders within a weak soil mass.

Turbidity

Turbidity, or the loss of water clarity, is due to the presence of suspended particles of silt and clay. Other materials, such as finely divided organic matter can also contribute to the loss of water clarity. At this time, none of the streams within the project area have been placed on the 303(d) list for sediment that increases turbidity**.** Turbidity is measured in NTU's (nephelometric turbidity units) and is an indicator of sediment or dissolved solids moving through the system.

Briggs Creek yields high water quality under normal conditions. Historically the greatest impact to water quality has been mining operations. Some of the earliest mining in the area dates back to the mid 1800s. Briggs and its tributaries have high water clarity under most flow conditions, at or below 5 NTU’s. The earliest measurements of effects that mining operations had on water quality of Briggs Creek was in 1976 below the Barr mine. On April 5, 1976, the water clarity below the active Barr mine was measured to be 272 NTU, which would equate to stream water with virtually no clarity. It was estimated that over a four month period, 70 tons of fine soils were added to the stream (Hansen, 1976). While no data is available, it is speculated that Briggs Creek significantly degraded the water quality of the Illinois River at that time

Improved water quality standards for mining operations have reduced impacts to water clarity. During the past decade, mining on Briggs Creek consisted of suction dredging that causes localized and short-term loss of water clarity. Currently, there are no approved plans of operations for any placer mining in Briggs Creek.

Turbidity was sampled and measured during the 1992, 1996, and 1999 wet season. Although peak flows were not represented, sampling did occur during storm periods. This study showed that when flows are rising and falling, turbidities range from .19 to 15 NTU on Briggs Creek in the Briggs Valley. The levels of turbidity at these sites are indicators of low-moderate amounts of fine suspended sediment and dissolved solids present during low-moderate storm events.

Dissolved Oxygen

Dissolved oxygen concentration refers to the amount of oxygen dissolved in water. Dissolved oxygen is important for the viability of fish and other aquatic life and for the breakdown of organic material. Dissolved oxygen concentrations are related to water temperature, such that when water temperatures increase, oxygen concentrations decrease. High concentrations are needed to benefit aquatic species. Low dissolved oxygen can stress aquatic species and lower resistance to environmental variables. Low concentrations can also lead to changes in water and sediment chemistry. Currently none of the streams in the project area are on the 303(d) list for dissolved oxygen. Review of watershed analyses for the area show that there is a lack of dissolved oxygen data.

Hazardous Materials

Based on review of watershed analyses, there are no records of sites where hazardous materials would be entering streams within the project area. On lands managed by the Forest Service, Best Management Practices are required which minimize risk of chemical spills during equipment use.

Riparian Reserves

One of the objectives in the Upper Briggs Creek project is to restore riparian reserves. Those goals are listed below:

- All project activities within riparian reserves will maintain or improve ACS objectives.
- Increase instream coarse woody debris where deficient and ensure adequate future delivery of coarse woody debris to stream channels.

- Increase the amount of large down wood and number of snags in riparian reserves where deficient.
- Use variable density or radial thinning, group selection, prescribed fire, directional falling, and/or targeted herbicide use to improve the diversity and composition of plant species within the riparian reserve to provide adequate temperature regulation, nutrient filtering, streambank stability, and amounts of coarse woody debris.

Riparian Reserves are lands along streams and unstable and potentially unstable areas where special Northwest Forest Plan Standards and Guidelines direct land use Reserves (USDA and USDI 1994). Intermittent streams, wetlands and unstable areas are included in Riparian Reserves. The Northwest Forest Plan Standards and Guidelines define intermittent streams as "…any nonpermanent flowing drainage feature having a definable channel and evidence of annual scour or deposition. This includes what are sometimes referred to as ephemeral streams if they meet these two physical criteria." Unstable and potentially unstable areas will include areas where Forest Service specialists have determined a potential for mass movement of soil, regardless of the presence of water or a defined channel.

Many of the candidate stands being considered for density management are known to contain Riparian Reserves. For the Upper Briggs Creek project, a stream network was generated from a digital elevation model. A mapped perennial channel is initiated when a collection area reaches 20 acres. The stream network was then "buffered" according to site potential tree height (180 feet for Upper Briggs Project), and fish-bearing status (one or two tree heights each side of stream course). Riparian Reserves and their appurtenant Standards and Guidelines apply where these reserves overlap land allocations other than Matrix (i.e., within Late-Successional Reserve). Consequently, field identification and marking of unmapped Riparian Reserves and validation of fish-bearing status will be required before implementation of treatments. Project Design Criteria for Riparian Reserves is located in Appendix A and B.

The vegetation in Riparian Reserves is comprised of riparian and upland forest communities. The more common and dominated species include Douglas fir, Port Orford cedar, ponderosa pine, canyon live oak, bigleaf maple, alder, pacific yew, tanoak, madrone and vine maple (SRG,2003). The forest vegetation is overstocked in some of the Riparian Reserves due to past fire exclusion and harvesting practices. In their present state, some of the riparian reserves are as vulnerable to stand replacement wildfires as the adjacent uplands.

Stream Flow
Several sub-watersheds come together in the project area of Briggs Valley (Horse, Dutchy, Brushy, and Meyers). Mainstem tributary summer low flows range from 2-3.5 cfs with average weather conditions. Extreme low flows during drought could be as low as 1 cfs.
Stream flow is measured quantitatively at gaging stations operated by the U.S. Geological Survey. Gaging stations nearest the project area are located on the Illinois near Agness. This station measures stream flow for an area much larger than the project area, and larger than the 6th field watershed in which the project area is located; thus, flow records do not contain information relevant to the scale of the project. Flows can be estimated using regional equations based on gage station data and watershed characteristic models (Cooper, 2005). Software utilizing the regional equations is available for use on the Oregon Department of Water Resources website (ODWR, 2008). The "autodelineation" feature of this software was used to select smaller watershed areas containing the proposed thinning units to generate flow information. The two year peak flow was selected as representative of bankfull discharge and most easily comparable

between watersheds. Bankfull discharges usually have recurrence intervals in the one to two year range. Table 3 outlines a calculated average flow per square mile of watershed area for the purpose of comparison.

Stream flow largely depends on the size of the area drained and how much precipitation it receives. In the transient snow zone, peak stream flows are often a direct result of rapid snowmelt combined with rainfall. Table 3 provides an index of variability (average stream flow per square mile) between the subwatersheds. They are similar with the exception of Horse Creek and Meyers Creek. Both these creeks occupy a smaller drainage and receive less rainfall resulting in a lower stream flow per square mile than those adjacent larger drainages at higher elevations where higher precipitation amounts occurs.

Table 3: Stream Flow

Subwatershed	Drainage Area (square miles)	2 year recurrence interval stream flow (cfs)	Stream flow per square mile of subwatershed at 2 year recurrence flow (cfs/square mile)
Dutchy Creek	2.14	334	156
Brushy Creek	1.26	189	150
Horse Creek	4.13	374	91
Upper Briggs Creek	4.71	746	158
Lower Briggs Creek	5.06	650	128
Meyers Creek	2.70	208	77
Onion Creek	11.80	1280	108
Secret Creek	6.76	690	102

Large Wood
In general, most of the main stem tributaries of Briggs Creek are 3rd to 5th order streams (intermediate sized streams) with enough stream power to move and redistribute large wood. Large in stream wood strongly influences the morphology of these stream channels and routing of sediment and water, and may be the principle natural factor in determining the characteristics and quality of localized aquatic habitats.
Over the longer term, timber harvest in riparian areas can have a beneficial or detrimental impact to channel stability by increasing or decreasing the availability of large woody material for recruitment to streams. Instream large wood aids in the trapping, storage, and sorting of sediment, and provides channel roughness that dissipates stream energy. Removal of trees from Riparian Reserves can affect source, number, size and mechanisms of delivery of large woody material to streams. In-channel large woody material in region 6 is defined as a minimum of 50 feet long with a diameter at breast height (DBH) of 36 inches at the small end. Currently, few of the trees within Riparian Reserves meet this criterion.

In riparian areas over-stocked with small diameter trees, thinning or partial timber harvest can be used to allow more rapid growth of the remaining trees, which over the longer term contributes to a more stable and functional channel.

There is limited recruitment of large woody material to riparian areas and stream channels partly due to human-related activities and maintained facilities on and near stream banks. Large in channel wood is scarce because large wood has been removed to facilitate roads, timber harvest, and stream cleaning. Past Timber harvest and mining activity has contributed to the loss. Horse, Meyers, Brushy, and Secret Creeks are currently deficient in their ability to contribute to future large wood supply.

Natural Disturbance

Droughts and floods have the potential to change the magnitude and frequency of stream flow. Southwest Oregon was in a drought cycle during 1985-1994. Lower than average flows were recorded in Siskiyou National Forest during these years.

There are few flow records or documented accounts of amount of stream flow resulting from flood events. The 1964 flood produced an estimated range of a 15-50 year event and a peak flow of 3500 cfs in Briggs Valley (Hanson, 1976). Flows were significant enough to move large wood through the mainstem and at the mouth of the major tributaries and to scour out bankfull and flood prone banks of lower mainstem riparian vegetation. No inner gorge or other landslides were recorded as a result of this event. It is expected that similar magnitude storm events would have similar localized effects on riparian productivity. Sediments moved from recent storm events have left minor long-term hydrologic effects (occasional localized bars or high channel terraces, prevention of late seral stage vegetation in bankfull-flood prone area).

Historic floods did not have cataclysmic site specific effects in this watershed. This may be attributed to the lack of local storm intensity or the lack of management related activity at the time of floods. In 1964, there were ½ the amount of roads and logged area than is present today.

There has been a general lack of natural fire in the watershed during the past 56 years (time period fire reports have been accurately kept). During this time period of fire suppression activities, large fires (over 5 acres in size) burned a total of only 81 acres. Fires suppression activities interrupted the natural fire cycle of the watershed (20-40 years for low-moderate intensity, 50-70 for moderate to high intensity, 200-300 years for stand replacement) and has increased the risk for catastrophic and stand replacement fire. Riparian reserves, especially those that contain intermittent and smaller perennial streams, are currently at higher than historic risk to stand replacement fire due to increases in fuel loading (brush and dead vegetation) related to the interruption of natural fire cycles. Many of these riparian areas would benefit from fuels reduction activity but should be assessed site specifically.

Timber Harvest

Past and present day timber harvest has had considerable influences regarding seral stage development in the sub-watershed including riparian reserves as shown on Table 4.

Table 4: Percent Affected By Management and Current Condition By Seral Stage

	BR	UB	ON	SC	HR	DT	MY
% Perennial Reserves Affected By Management*	13	16	38	58	43	19	82
% Class I, II Reserves**							
Early Seral	N/A	55	42	52	61	49	57
Mid Seral	N/A	27	33	29	23	25	26
Late Seral	N/A	18	25	19	16	21	17
% Class III Reserves **							
Early Seral	48	44	48	64	66	46	63
Mid Seral	39	40	27	33	18	48	23
Late Seral	13	16	25	3	16	6	14

BR (Brushy Cr), UB (Upper Briggs), ON (Onion Cr), SC (Secret Cr), HR (Horse Cr), DT (Dutchy Cr) MY (Meyers Cr).
*This % was calculated by length of riparian reserve, not by acres. A harvest unit or road within a riparian reserve was credited with affecting 100% of the riparian reserve length for the distance in km that it resided. One km. of road in a riparian reserve therefore affected 100% of the riparian reserve for one km.
**This % was calculated by acres.

Pre-harvest seral stage distribution values naturally range from; early=10-40%, mid=10-15%, late=45-75%. These values will help to identify and prioritize which sub-watershed's riparian reserves would generally benefit from activities which would promote mid-late seral vegetation. Riparian Reserves generally are lacking in late seral stage vegetation.

Approximately 18% of the watershed, has been harvested, reverting mid-late seral stage vegetation to early seral conditions. This is well below the level of concern for water yield effects. The predominant localized effects include the lack of both standing and down large wood on these acres.

Environmental Consequences

Alternative 1- No Action

Water Quality

The "No Action" Alternative would have no direct effects to water quality since there would be no thinning or prescribed fire activities implemented. Natural recovery and processes would continue to occur. The composition and character of forest stands adjacent to streams would not be altered. Thus, there would be no effect to stream shading and no change to stream temperature. The risk of stand replacement fire would remain unchanged in overstocked stands which could result in extensive mortality within Riparian Reserves if this type of fire occurred. Stand replacement wildfire could reduce the supply of future large wood recruitment and reduce stream shade. Therefore, there could be an indirect effect on stream temperature in the project area. There could also be effects to stream temperature from channel widening (See Channel Morphology – Coarse Sediment section below.)

There would be no direct effects from fine sediment to streams from the "No Action" Alternative. Since there would be no soil disturbance from management activities, there would be no fine sediment delivery and no change in turbidity. Indirect effects could occur from the increased risk of stand replacement fire in Riparian Reserves (See above.) Stand replacement wildfire could trigger erosion and increase fine sediment inputs to stream channels. This could have adverse impacts on turbidity.

If sediment delivery and temperature increase due to the impacts of stand replacement wildfire (see above), there could be effects to macroinvertebrates and dissolved oxygen. Increases in temperature and fine sediment inputs to streams could affect macroinvertebrate populations. Dissolved oxygen could be impacted by increases in stream temperature through loss of stream shading or channel widening from increased coarse sediment delivery (See Channel Morphology – Coarse Sediment section below.)

Channel Morphology – Coarse Sediment

There would be no direct effects to channel morphology from implementation of the "No Action" Alternative. Since there would be no treatment and no erosion through soil displacement, there would be no adverse impacts. Natural recovery and processes would continue to occur. If stand replacement wildfire occurred in Riparian Reserves (See above), there could be indirect effects on coarse sediment. Erosion triggered by this type of wildfire could cause channel changes, such as pool filling, channel widening, and stream bank failures. Channel widening could have subsequent effects on water quality by causing increases in stream temperature.

Riparian Reserves - Riparian Vegetation

The "No Action Alternative" would have no direct effects to riparian vegetation and large wood recruitment in Riparian Reserves. There would be no direct loss of vegetation through thinning or prescribed burning activities. Natural recovery and processes would continue to occur. However, the risk of stand replacement fire would remain unchanged in overstocked stands which could result in extensive mortality within Riparian Reserves if this type of fire occurred.

Although the future supply of large wood to stream channels could be reduced due to extensive mortality from fire, there could be in increase in the amount of large wood in the stream channels in the short term, depending on the severity to which trees are burned.

Peak Flows

The “No Action” Alternative would have no direct effects to peak flows since there would be no thinning or prescribed fire activities implemented. Natural recovery and processes would continue to occur. However, the risk of stand replacement fire would remain unchanged in overstocked stands which could result in extensive mortality within Riparian Reserves if this type of fire occurred. Depending on the extent and severity of the wildfire, there could be a subsequent increase in peak flows. There would be an increase in young stands and the watershed would not be considered hydrologically recovered.

Effects Common to All Action Alternatives (Alt 2 and Alt 3)

System Road Decommissioning, Storage, and Stream Crossing Improvements

As shown on Figure 6 both action alternatives involve the decommissioning and roadbed restoration of 11.1 miles of system roads, the storage (convert to Maintenance Level 1) of 1.6 miles of system roads, and stream crossing improvement at 4 road crossings. Table 5 below provides the list of roads and proposed activities. Additional road information related to soil effects can be found in the Upper Briggs Creek Soil Specialist report.

Table 5: Roads proposed for a decommissioning, storage, and/or with proposed stream crossing improvement (from Soil Specialist Report)

Road Number	Current ML*	Summary of Actions	ML Recommendation	Miles of ML change
2402149	ML1	Relocate Trail 1146 Dutchy Creek-Chrome Ridge TH to FSR 2402; restore roadbed, convert to trail 1146	Decommission	0.3
2402150	ML1	Relocate Trail 1146 Dutchy Creek-Chrome Ridge TH to RSR 2402; restore roadbed, convert to trail 1146	Decommission	0.7
2402610	ML1	Relocate unofficial 1146 TH to FSR 2402; restore roadbed	Decommission	0.9
2500099	ML1	Improve hydrologic function of Myers Creek tributary stream crossing; restore roadbed from 2500606 junction to end	ML1/Decommission	0.3
2500100	ML2	Restore roadbed from Windy Creek to end; pull 5 foot culvert & restore Windy Creek channel	Decommission starting at Windy Creek culvert, to end	0.7
2500121	ML1	Improve hydrologic function at 3 tributary stream crossings to Smith Creek	ML1	n/a
2500152	ML1	Restore roadbed	Decommission	0.7
2500160	ML2	Restore roadbed	Decommission	0.8
2500162	ML2	Restore roadbed	Decommission	0.2

2500163	ML2	Restore roadbed; pull landing fill out of stream channel	Decommission	0.1
2500172	ML2	Place road into Storage	ML1	0.4
2500175	ML1	Restore roadbed	Decommission	0.7
2500603	ML2	Restore roadbed; pull 3 stream crossing culverts and restore channels	Decommission	1.0
2500605	ML1	Restore roadbed	Decommission	0.5
2500608	ML1	Restore roadbed	Decommission	0.3
2500609	ML1	Restore roadbed; pull 1 stream crossing culvert and restore channel	Decommission	0.4
2500617	ML1	Restore roadbed; pull Smith Creek, Horse Creek, and 6 tributary culverts, restore channels	Decommission	1.5
2500660	ML1	Restore roadbed	Decommission	0.2
2500665	ML2	Restore roadbed	Decommission	1.2
2500667	ML2	Restore roadbed	Decommission	0.1
2500668	ML2	Restore roadbed	Decommission	0.1
2500670	ML2	Restore roadbed	Decommission	0.2
2500671	ML1	Restore roadbed	Decommission	0.2
2509032	ML2	Place road into Storage	ML1	0.8
2509631	ML2	Place road into Storage	ML1	0.1
2509632	ML2	Place road into Storage	ML1	0.1
2509633	ML2	Place road into Storage	ML1	0.2
2512632	ML2	Restore roadbed; convert to trail 1146	Decommission	0.2

*ML = Maintenance Level

Road decommissioning, storage, and stream crossing improvement on these identified roads provide an opportunity to minimize risk of road failures along road prisms, by providing proper drainage and improving areas that are recognized to be at risk of failure. In particular, the decommissioning of FSR 2500617 would eliminate the potential for fillslope failures at multiple channel crossings as well as linear fillslope locations that are currently showing evidence of instability (fillslope cracking and slumping).

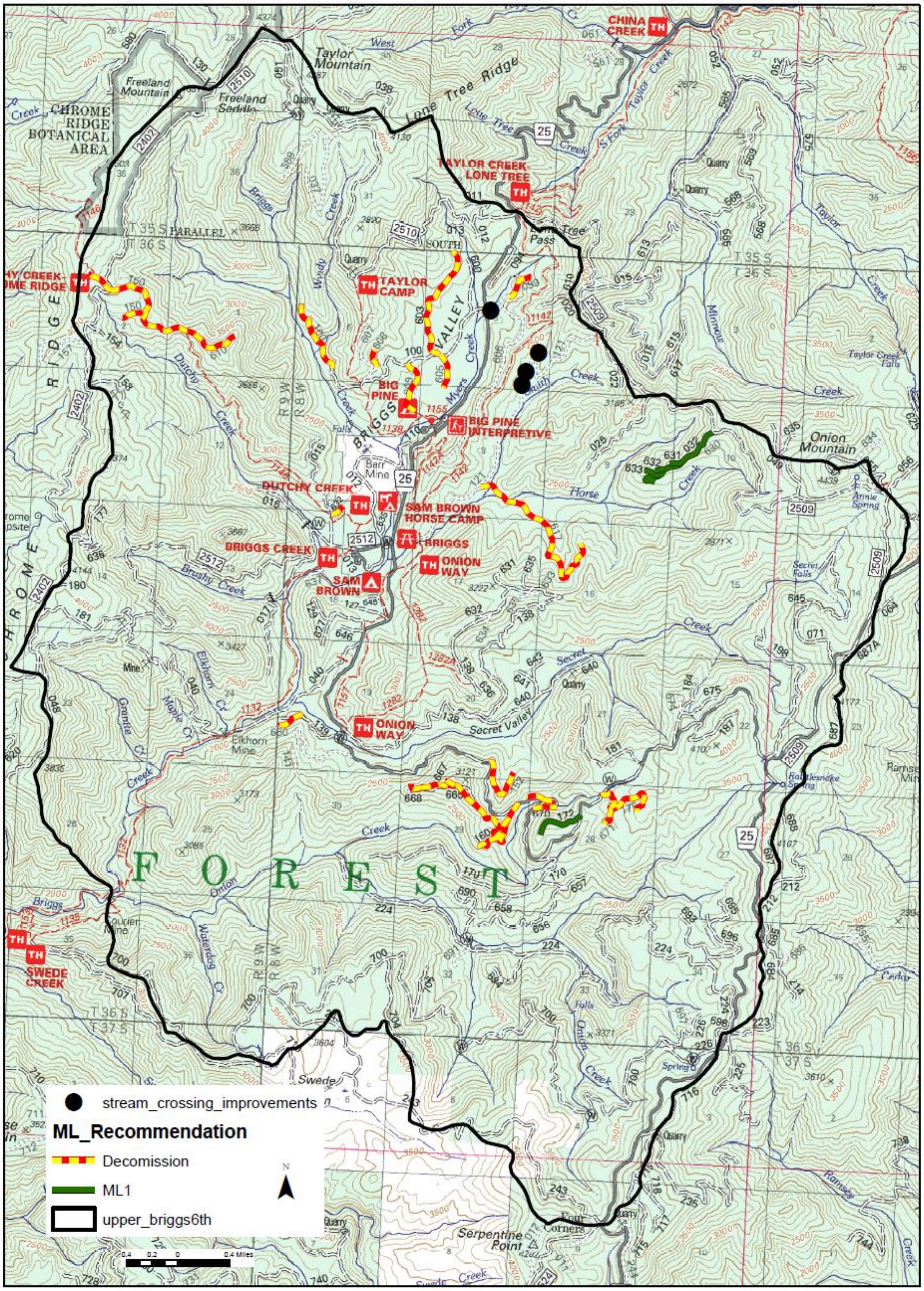
Project Design Criteria and Mitigation Measures that have been designed for the Upper Briggs Creek project, including best management practices (BMPs) for temporary and system road activities in the National Core BMP Technical Guide (USFS 2012) and the Region 6 General Water Quality Best Management Practices (USFS 1988), have influenced the planning of road activities during project development. They would be implemented to reduce or eliminate potential future failure risk on system roads to be decommissioned, put into storage, and storm proofed at stream crossings.

System road decommissioning, for roads that are no longer needed, would involve taking the road off the road system and restoring the roadbed. Roadbed restoration could include any combination of the following potential actions for road decommissioning: shallow ripping, deep subsoiling, partial to full roadfill pullback/recontouring, mulching/placing slash, pulling cross-drain and drainage culverts and associated fill, shaping stream crossings to natural channel dimensions, water-barring, seeding, planting, and blocking the entrance with a barrier (such as berm construction and/or boulder placement). No ground disturbing actions may be needed where a roadbed is already on a successful passive restoration trajectory (from Upper Briggs Soil Specialist report).

"Storage", for roads that are currently not needed but will be in the future, could include any combination of the following potential actions for converting an open, system road to Maintenance Level 1, closed: pulling cross drain and drainage culverts and associated fill, ripping or subsoiling a portion of the roadbed, installing rolling dips, water barring, seeding, mulching/placing slash, and blocking the road entrance with a barrier (such as berm or gate). Putting a classified road into storage still commits the soil resource to something other than soil productivity over the long term. However, eliminating regular use of the road reduces the potential for surface erosion, as organic matter builds up on the road prism. Over time with continued closure, some shallow rooted vegetation is able to establish in the road prism and temporarily improve productivity, until the road is re-opened (from Upper Briggs Soil Specialist report).

Storm proofing (for stream crossing improvements), roads currently needed and needed into the future, would improve the hydrologic function of these systems and reduce or eliminate the potential for fill failures at the crossings during high flow events, which would reduce or eliminate the potential domino effects of downstream inner gorge slope failures or mass wasting that can occur when road crossings blow out (from Upper Briggs Soil Specialist report).

Figure 6: Road Decommissioning and Stream Crossing Improvements



Water Quality
Fine Sediment and Turbidity (Suspended Sediment)

Road Decommissioning/storage/stormproof

Culverts in the stream channel can be removed as part of road decommissioning and storage. Culverts can also be removed and replaced with upgrades as part of storm proofing. Both of these activities could cause localized and short term increases in turbidity. The effects are minimal and short term and the benefit of removing the culverts far exceeds the risk to the aquatic system if the culverts are left in place.

Water Quality
Stream Temperature

Thinning within and outside of Riparian Reserves

Stream temperature is affected by riparian vegetation shading and channel form. Riparian Reserves act as buffer strips, moderating water temperature by intercepting incoming solar radiation (Brazier and Brown, 1973). For a given treatment, the amount of shade lost following vegetation removal is dependent on stream width, tree height, vegetation proximity to the stream, and stream orientation. Thinning can remove trees that are providing stream shade which can increase summer stream temperatures. Figure 7 illustrates the effects of riparian thinning (e.g., reduced basal area) on increasing stream temperature.

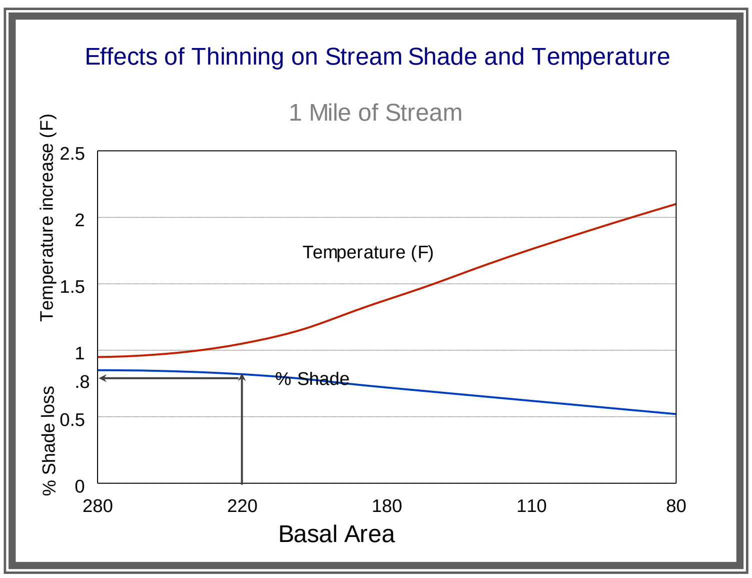


Figure 7: Modeled effects of thinning on stream temperature (SHADOW).

Implementation of the Northwest Forest Plan accommodates vegetation treatment necessary or desirable to restore ecological health in Riparian Reserves that have been harvested or affected by fire exclusion or other disturbance. The Northwest Forest Plan Temperature Strategy, developed for the Forest Service, Bureau of Land Management and Oregon Department of Environmental Quality, demonstrates that thinning can occur in the Riparian Reserve without affecting stream shade if the overstory canopy in the primary shade zone is not treated. The following table from the NWFP Temperature Strategy defines the primary shade zone and area of no overstory treatment to be applied to protect shade on perennial streams (USDA Forest Service, ODEQ, and BLM, 2012).

Height of Tree	Hill slope <30%	Hill slope 30 to 60%	Hill slope >60%
Trees < 20 feet	12 feet	14 feet	15 feet
Trees 20 to 60 feet	28 feet	33 feet	55 feet
Trees >60 to 100 feet	50 feet	55 feet	60 feet
Trees > 100 to 140 feet	70 feet	75 feet	85 feet

Table 6: Minimum Width of Primary Shade Zone (feet) based on Slope and Tree Height

No impacts to stream temperature would be expected from thinning because existing stream shade would be maintained. Activities would be implemented according to the parameters in Table 6 above and the Project Design Criteria in Appendix B, such that the primary shade zone is not treated.

Increased sediment loading can cause the channel to become wider and shallower, exposing more surface area to solar radiation, resulting in higher stream temperatures. No channel changes would occur from the proposed activities (See Coarse Sediment section).

Haul of Logs and Road Maintenance

Forest Service regulations require that haul roads be maintained for safe travel. Roadside brushing is necessary for visual safety. This requires the cutting of roadside vegetation and could include riparian vegetation at stream crossings (Figure 8).

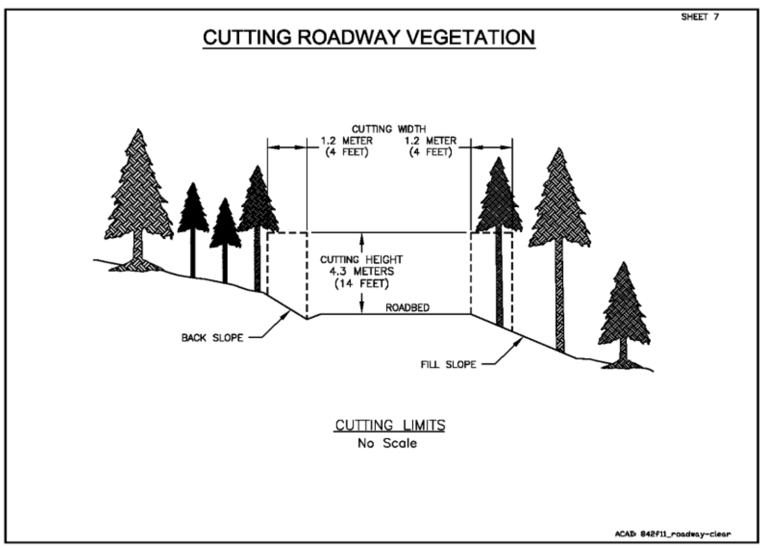


Figure 8: Typical showing roadside brushing.

Vegetation pruning is the removal of branches from the ground up to a height of eight feet. The treatment will remove only the bottom branches of the tree and maintain the overstory canopy. Since roads are usually constructed outside the flood zone of a stream and trees are located back away from the stream, trees that can provide stream shade along a roadside are typically 50 feet or taller. For trees 50 feet tall, pruning will not remove branches in the upper 75% of the crown. Thus, the portion of the tree that provides most of the shade throughout the day would not be affected (Figure 9). Further, none of the trees that are proposed for treatment overhang the stream. For stream crossings, the road fill over the culvert shades the stream, not riparian vegetation. Thus, road maintenance activities would not affect stream temperature.

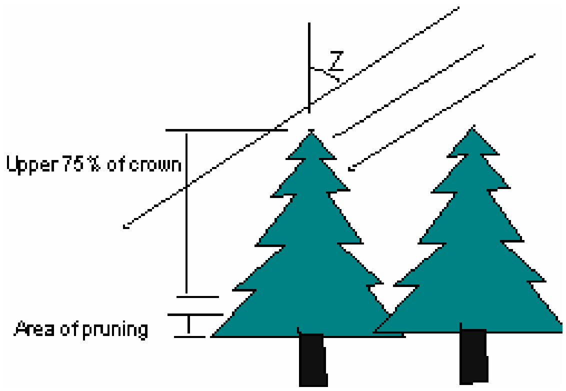


Figure 9. Tree shading

Water Quality

Fine Sediment and Turbidity (Suspended Sediment)

Thinning within and outside of Riparian Reserves

Soil disturbance from management activities can cause sediment to be delivered to a stream. Sediment delivered to a stream most often is comprised of both suspended sediment (silt and clays) and coarser materials (sand and gravels) that are transported as bedload. Suspended sediment that can affect water clarity is usually quickly transported through the stream system.

Sediment can either be delivered by mass wasting or surface erosion. Mass wasting can deliver large amounts of sediment in a short time. Following mass wasting to a stream, there is an accompanying increase in turbidity from fine sediment. Surface erosion delivers a smaller amount of sediment over a longer time period. Rather than affecting whole stream systems, such as mass wasting, fine sediment from erosion usually causes localized increases in turbidity or it is so small that it is undetectable.

Several studies have been conducted to determine the effectiveness of riparian buffers in reducing sediment delivery to a stream from upslope skyline timber harvest. All of the studies used clear cut harvest methods, and not the less impacting method of thinning as proposed in this project. In these studies, buffer widths of 100 feet were found to be effective in preventing sediment delivery from timber harvest (Lynch et al. 1985, Moring 1982).

Following salvage logging of the fire killed trees from the 1987 Silver Fire on the Siskiyou National Forest, the effectiveness of riparian buffers were monitored before and after helicopter harvest. The Silver Fire used the following Siskiyou Forest Plan buffer widths: 150 feet on fish bearing streams; 100 feet on perennial streams; and 25 feet on intermittent streams. A summary of the monitoring results found that buffer areas were very effective in maintaining stream bank integrity as well as blocking sediment delivery (Kormeier 1995).

For the Upper Briggs Creek Project, all units where thinning and subsequent harvest of merchantable trees would occur would have a designated Riparian Reserve of 360 feet on fish-bearing perennial streams, 180 feet on non fish-bearing perennial streams, and 180 feet on intermittent streams and wetlands. The proposed Riparian Reserves are greater than or equal to the widths found in the studies described above (Corbett and Lynch 1985, Lynch et al. 1985, Moring 1982, Kormeier 1995) to prevent sediment delivery to streams and maintain stream bank integrity. Further, with the less disturbing activity of thinning (as compared to clear cut methods used in published studies), the Riparian Reserves would be more than adequate to prevent any fine sediment from reaching a stream. By implementing the Riparian Reserve widths and the Project Design Criteria as described in Appendix A and B. there would be no increase in fine sediment delivery to a stream or associated increase in turbidity from thinning activities.

Haul of Logs and Road Maintenance

Road maintenance, such as blading and ditch cleaning, and haul traffic are two activities that affect sediment production from forest roads. Road grading can break up the armor layers on the road surface or the ditch and temporarily increase road surface erosion. The Rocky Mountain Research Station conducted a study on the effects of traffic and road maintenance on forest road sediment production in the Oregon Coast Range. The study compared the sediment production from road maintenance (blading) and the combination of road maintenance with heavy traffic. The study concluded that the difference between grading-only and grading with traffic was not statistically significant (Luce and Black 2001). These conclusions are based on the assumption that there would be no wet weather haul. There would be no wet weather haul permitted with the Upper Briggs Creek Project. Although road maintenance is programmatic and does not require a project level cumulative effects analysis, the study by Luce et al. demonstrates that traffic on these roads does not increase sediment production. Thus, there would be no further impacts from road sediments as a result of log hauling on maintained roads if there is no wet weather haul.

Most of these road segments are on slopes less than 30%. Based on the locations of existing roads and implementation of BMPs (USDA 1988 and 2012), effects of sediment to streams from haul of logs and road maintenance would be minimal.

Water Quality
Biological Criteria

Thinning, Haul of Logs, Road Maintenance, and Prescribed Burning Activities

None of the streams in the project area are listed as water quality limited for macroinvertebrate populations. Since there would be no increase in stream temperature or sediment (see stream temperature, fine sediment, and coarse sediment sections) from the proposed action, no effects to biological criteria would be expected

Water Quality

Dissolved Oxygen

Thinning, Haul of Logs, Road Maintenance, and Prescribed Burning Activities

None of the streams in the project area are listed as water quality limited for dissolved oxygen. The only potential effects on reducing dissolved oxygen from the proposed activities would be a reduction in stream shade or mass wasting of sediment into a stream resulting in changes to channel morphology. There would be no loss of stream shade (See Temperature section) or increase in sediment delivery (See Fine and Coarse Sediment sections.) No changes in dissolved oxygen associated with the proposed activities would occur.

Hazardous Materials

Thinning, Haul of Logs, Road Maintenance, and Prescribed Burning Activities

The project does not place equipment near stream channels where it would be possible for chemicals to spill. A spill plan will be in place prior to any activity which would encompass appropriate BMPs for minimizing any risk of spills associated with equipment use.

Channel Morphology – Coarse Sediment

Thinning within and outside of Riparian Reserves and Prescribed Burning Activities

Coarse sediment, sands, and gravels are transported in a stream as bedload. Excessive amounts of coarse sediment in a stream as compared to the stream's ability to transport it can cause channel changes such as pool filling, burial of spawning gravels, channel widening, and stream bank failures. Logging activities can increase the rate of erosion through soil displacement by logging equipment, cable yarding, and skidding of logs.

To detect changes in channel morphology from sediment delivery following riparian thinning and burning, photo points were established on a stream prior to activities for the 1995 Waters Thin Project. Monitoring sites on the stream included areas sensitive to increases in sediment delivery and flow from the project activities. This included a pool, a vertical stream bank on a bend, and a vegetated low gradient section. In January 1997, two years after the project activities, there was a 50-year storm event. Comparison of the 1995 and 2005 photo points showed no change in the stream channel. There were no sediment deposits in the pool or low gradient stream section. The stream bank was unchanged. No evidence of sediment movement was present in the 25-foot no treatment area or in the riparian area where thinning and burning occurred (Park and Jubas 2005). Based on the similarity in treatments between the Waters Thin Project and the Proposed Project, no effects from coarse sediment as a result of thinning and prescribed burning would be expected.

The proposed buffers are more than adequate to prevent any sediment from reaching a stream (See Fine Sediment section). There would be no increase in coarse sediment delivery to a stream from thinning or prescribed burning activities.

Haul of Logs and Road Maintenance

Fine sediment delivery, not coarse sediment, is associated with haul and maintenance (See Fine Sediment section.) No coarse sediment delivery to a stream would occur from haul of logs and road maintenance.

Alternative 2 - Proposed Action

There are 4,017 acres within the proposed vegetation treatment units in Alternative 2 (Figure 1; Table 7). This includes all of the primary management objectives (develop and enhance late seral habitat (DELSH), restore pine-oak communities, restore sensitive plant habitat, restore meadow systems, restore riparian reserves, and create and maintain strategically located fuel management zones (FMZs)). Treatments would involve multiple silvicultural prescriptions, including variable density thinning to 60 or 40% canopy cover, hardwood retention, and ¾ acre maximum patch cuts. Fuels treatments would involve pruning, piling, and burning post vegetation treatment, with underburning 1 to 5 years post treatment. Treatment methods would involve a combination of manual (hand) work, and mechanized equipment including ground-based, cable-yarding, and helicopter equipment. It is estimated that approximately 3 miles of temporary roads would be needed to provide temporary access to meet project objectives.

Table 7: Treatment Objective and Proposed Acres Treated for Alternative 2 and Alternative 3

Primary Treatment Objective	Alternative 2 Acres Treated	Alt 2 % Watershed	Alternative 3 Acres Treated	Alt3 % Watershed
DELSH	1053	4%	556	2%
Riparian Restoration	183	<1%	128	<1%
Roadside FMZ	713	3%	794	3%
Pine Oak	706	3%	479	2%
Rare Plants	42	<1%	42	<1%
Meadow Restoration	188	<1%	126	<1%
Ridgeline FMZ	1132	4%	503	2%
Total Acres	**4017**	**16%**	**2628**	**11%**

Water Quality

Stream Temperature

Temporary Road Construction

There is no new road construction proposed in this project. There would be a maximum of 3 miles of temporary road construction. Temporary roads would be defined as a created travel way, for the purpose of transporting logs that is built, utilized, and decommissioned (obliterated) over the course of the treatment. Temporary roads would **only include** reconstruction of existing non-system roads where there is an existing road template. The obliteration of these roads would occur at the completion of their intended use and be left in an improved condition. In addition, no new temporary roads would be located within Riparian Reserves. Therefore, there is no loss of vegetation within the primary shade zone and no effect to stream temperature from temporary roads. No sediment from temporary road construction will affect stream channel morphology of perennial, intermittent, or ephemeral streams (See Coarse Sediment section). Thus, no increase in stream temperature would occur from channel widening due to temporary roads.

Prescribed Burning Activities

Fuels treatment in Riparian Reserves would be accomplished by manual thinning and backing prescribed fire into the riparian area. Ignition points would not occur closer than 100 feet from perennial streams. In addition, no hand piles would be burned within 25 feet of a stream (Appendix A).

Similar treatments were implemented on the Forest for the 1995 Waters Thin Hazardous Fuels Reduction Project (Waters Thin Project). For this project, monitoring sites were established to determine if there were any changes in the stream channel or shade as a result of the thinning and fuels treatment. The monitoring sites were established to validate the findings in the 1995 Waters Thin Hydrology Cumulative Effects Analysis that concluded there would not be a significant risk to the integrity of the aquatic system if the treatments occurred. Sites were monitored before thinning and fuels treatment began. Monitoring included measuring stream shade using a solar pathfinder and tracking channel changes using photo points. This baseline data was then compared to data collected in 2005 after treatment and several winter storms including the 1997 storm that was a 50-year event (Park and Jubas 2005).

Based on monitoring results of past prescribed fire treatments in the Waters Thin Project (Park and Jubas 2005), fire in Riparian Reserves for the Upper Briggs Creek Project would be a low intensity ground burn stopping at least 25 feet from the stream. In addition, no primary shade zone overstory riparian canopy (Table 6) would be affected by the prescribed burning activities. Therefore, there would be no increase in stream temperature from prescribed burning.

Water Quality
Fine Sediment and Turbidity (Suspended Sediment)

Temporary Road Construction

There is no new road construction proposed in this project. There would be a maximum of 3 miles of temporary road construction. Temporary roads would be defined as a created travel way, for the purpose of transporting logs that is built, utilized, and decommissioned (obliterated) over the course of the treatment. Temporary roads would **only include** reconstruction of existing non-system roads where there is an existing road template. The obliteration of these roads would occur at the completion of their intended use and be left in an improved condition. In addition, no new temporary roads would be located within Riparian Reserves. No sediment from temporary road construction will affect stream channel morphology of perennial, intermittent, or ephemeral streams (see Coarse Sediment section).

Prescribed Burning Activities

Fuels treatment in riparian areas will be accomplished by manual thinning and then backing prescribed fire into Riparian Reserves to reduce fuels. Monitoring results of past prescribed fire activities in the 1995 Waters Thin Project show that the fire will be a low intensity ground burn, stopping at least 25 feet from the stream. No surface erosion, that could deliver fine sediment to a stream, has been detected in the monitoring of that project (Park and Jubas 2005). Based on the similarity in treatments between the Waters Thin Project and the Proposed Project, no effects from fine sediment as a result of prescribed burning would be expected.

Even with some loss of short term infiltration associated with moderate and high intensity wildfires burns, it is rare to observe overland flow and surface erosion on the Rogue River-Siskiyou National Forest-managed lands. Turbidity was monitored following the 1987 Silver Fire and subsequent salvage logging. A summary of the data concluded, “There have been no noticeable effects in increases in turbidity or sediment” and “Turbidity does not appear to be a significant area of concern” (Kormeier, 1995). In addition, after the Biscuit wildfire in 2002, no changes in turbidity were observed or monitored following the first winter (Jubas 2005). Thus, since prescribed burning activities are less disturbing than wildfire burns, prescribed fire (as implemented according to PDCs in Appendix A) in Riparian Reserves would not cause fine sediment to be delivered to streams. Therefore, there would be no resulting increase in turbidity.

Riparian Reserves - Vegetation

Variable Density Thinning

Variable density thinning (VDT) is proposed in both managed stands and natural stands. These stands are primarily even-aged or two aged. Single storied plantations or even-aged as the result of fire disturbance. These stands are dominated by Douglas-fir. This treatment aims to enhance structural and species diversity, and result in a stand containing a variety of stand densities for development into late-successional conditions to meet Aquatic Conservation Strategies (USDA, USDI 1994). The desired variability and structural complexity from this treatment is explained under *Density Management* (see silviculture specialist report). Treatments would retain at least 60 percent canopy cover and other habitat features in both dispersal and NRF habitat. Management scenarios would differ by harvest system. Stands that would maintain at least 60 percent canopy cover where helicopter yarding is proposed would see gap-only treatments ranging in size from 1/5 to ¾ acre. Stands in upland riparian reserves would maintain at least 60 percent canopy cover in NRF and dispersal habitat. Treatments would retain components of understory and intermediate trees for complex structural development. Thinning would be distributed across canopy layers and tree classes, create canopy gaps, and vary in tree sizes and species.

A total of 957 acres is proposed for riparian reserve treatment under Alternative 2. Secret Creek subwatershed will have the largest number of riparian acres treated or 291 acres followed by Horse Creek at 245 acres. Overall, 14% of riparian reserves in the Project area will be treated as shown in Table 8, Table 9 and Figure 10.

Table 8: Alternative 2 – Proposed Treatment Summary in Riparian Reserves

Subwatershed	Riparian Reserves (acres)	Treatment in Riparian Reserves (acres)	Percent of Riparian Reserve Treatments in each subwatershed
Brushy Creek	192	0	0
Dutchy Creek	364	6	1.6 %
Horse Creek	770	245	29 %
Lower Briggs Creek	969	105	11 %
Meyers Creek	672	237	35 %
Upper Briggs Creek	735	25	3.4 %
Onion Creek	1926	48	2.5 %
Secret Creek	1086	291	27 %
Overall Total (Project Area HUC 6)	6714	957	14 %

Thinning within and outside of Riparian Reserves and Prescribed Burning Activities

The perennial portions of the Riparian Reserves proposed for thinning and prescribed burning have been harvested in the past. Since much of the project area has been harvested, there is a shortage of large wood for recruitment. Thinning would increase tree growth and lessen the time needed to establish future large wood delivery. Both thinning and fuels treatment would lower the likelihood of a stand replacement fire in the overstocked Riparian Reserves.

Corridors for cable rigging needed for skyline operations would be allowed to pass through Riparian Reserves. A maximum clearing width of 12 feet is required and logs may be yarded through these perennial corridors. Corridors are required to be spaced at a minimum of 200 feet apart. If skyline operations occur through Riparian Reserves, vegetation would be impacted by this clearing and subsequent yarding. Loss of vegetation through these areas would occur. Corridor “rub trees” would be left on site if impacted or felled.

By implementing PDCs (Appendix A and B), the Northwest Forest Plan Temperature TMDL Implementation Strategies (Table 6) and BMPs (USDA Forest Service 1988 and 2012), impacts to riparian vegetation would be minimal. No timber harvest or fuels treatments would be allowed within 25 feet of streams. Since most of the riparian areas on streams with the project area are located within 25 feet of the stream channel, the riparian vegetation would not be impacted by the proposed treatments.

Stand Examination data collected in 2008, 2011 and 2015 were used in the FSVeg Spatial Data Analyzer to perform a robust statistical analyses for desired future conditions (see Silvicultural Specialist Report). Riparian Reserve Stand summaries are listed below with desired future conditions set for 40 years which will include commercial thinning, fuels thinning, punning, piling, pile burn and under burns. Modeling results show Riparian Stands would maintain the proposed desired condition of 60% canopy cover (Table 10).

Table 9: Riparian Treatment Acres in Alternative 2 Proposed Units

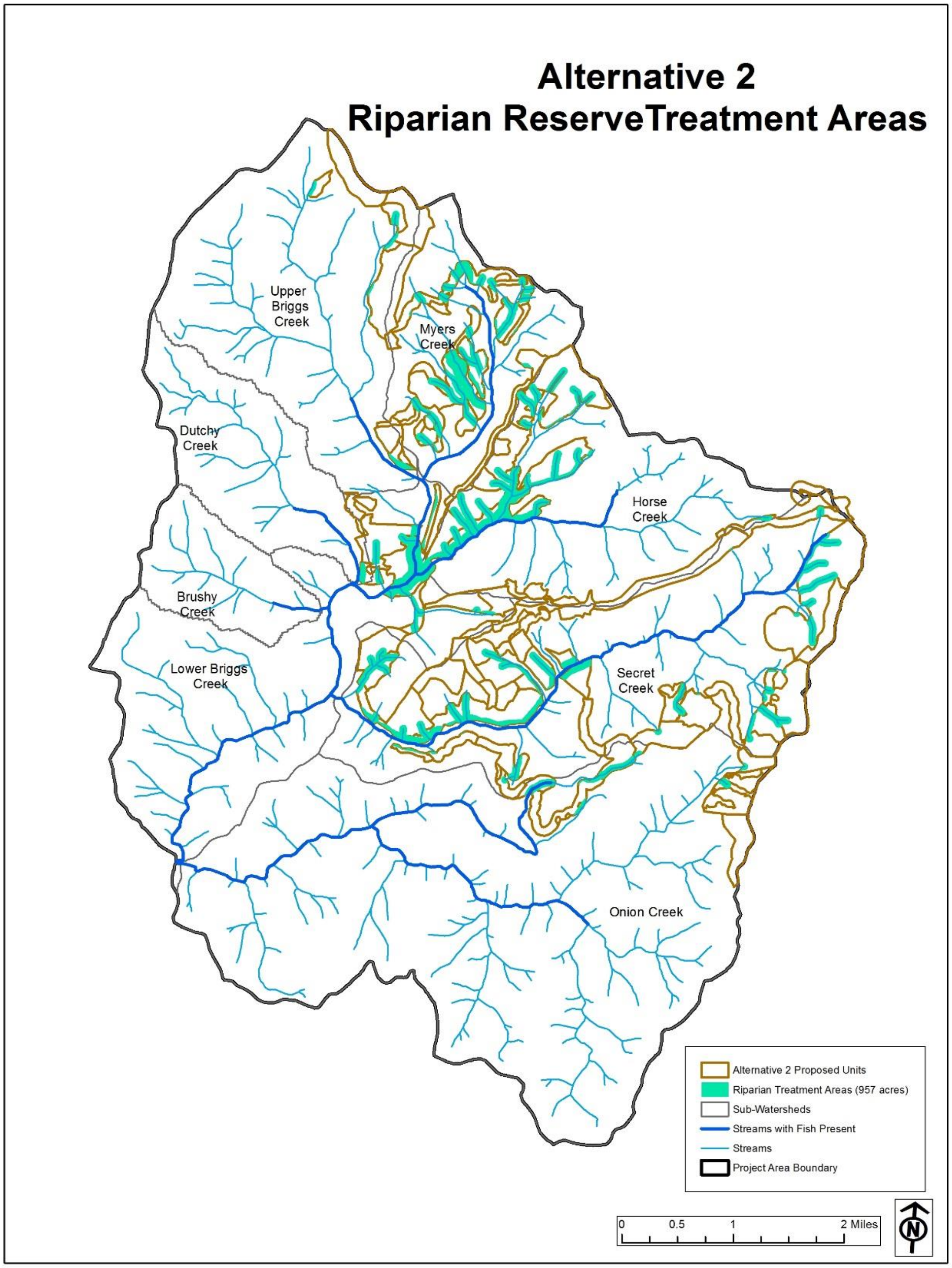
Unit No.	Primary Objective Alternative 2	Treatment Acres Primary Shade Zone (25 -85 feet). Limited **understory** treatments only.	Treatment Acres adjacent to Perennial (85-360 feet)	Treatment Acres adjacent to Intermittent (25-180 feet)
1	FMZ	-	-	1.1
2	DELSH	-	6.7	16.1
3	Pine Oak/rare	-	1.3	48.4
3S	Rare Plants	-	3.1	8.3
4	DELSH	1.0	4.0	13.4
5	DELSH	-	-	8.1
8	DELSH	-	-	5.1
9	DELSH	-	-	13.6
10	Pine Oak	-	-	23.5
11	Meadow	-	-	1.8
12	DELSH	0.3	6.8	-
12A	DELSH	-	-	1.3
14	DELSH	-	-	4.4
16	DELSH	-	-	6.4
20	FMZ	-	-	0.3
21	Pine Oak	-	5.2	8.9
22	Pine Oak	-	-	3.5
24	DELSH	-	-	0.9
26	FMZ	-	-	0.1
29	FMZ	-	-	0.1
31	DELSH	0.5	5.4	1.9
31A	DELSH	-	-	0.1
31B	Riparian	-	3.9	13.2
32	Pine Oak	-	-	29.3
36	DELSH	-	-	1.9
38	FMZ	-	-	5.6
39	Pine Oak	-	-	3.3
42	FMZ	-	-	0.1
43	FMZ	-	-	10.3
47	FMZ	-	-	2.6
48	Meadow	12.9	49.8	45.7
50	Meadow	17.1	61.3	16.1
51	DELSH			5.5
55	Pine Oak	1.5	9.5	10.2
57	FMZ			1.8
58	FMZ			62.2
59	DELSH			0.9
61	FMZ/DELSH			4.3
63	Riparian	1.1	38.7	24.8

64	DELSH			9.6
67	FMZ			14.3
69	DELSH			4.7
70	DELSH			
71	DELSH			2.4
80	DELSH	0.9	10.2	0.9
101	DELSH			2.9
102	Pine Oak			12.6
103	FMZ			
104	Riparian			2.5
118	FMZ			0.3
165	DELSH	0.5	6.0	4.4
240	DELSH		1.3	17.4
253	DELSH		1.6	
262	DELSH	9.6	36.6	14.8
500	Roadside FMZ	2.1	12.3	28.2
501	Roadside FMZ			8.1
502	Roadside FMZ		0.7	
503	Roadside FMZ			3.7
504	Roadside FMZ			8.6
505	Roadside FMZ		0	13.9
506	Roadside FMZ			0.1
507	Roadside FMZ		4.6	
509	Roadside FMZ			10.5
510	Roadside FMZ		5.5	4.8
511	Roadside FMZ			0.2
513	Roadside FMZ		3.3	26.5
516	Roadside FMZ			5.6
517	Roadside FMZ			7.1
652	DELSH			21.8
SUBTOTAL		**47.5 acres**	**278 acres**	**631 acres**
TOTAL	**956.5 Acres**			

Table 10: Silviculture Modeling Results for Riparian Stands

Year	Average Uniform Canopy Cover (%)	Average Tree Top Height (ft)
2017	85	107
2018	79	103
2022	76	107
2027	76	111
2037	77.1	120
2047	77.4	128
2057	77.5	136

Figure 10: Alternative 2 Riparian Reserve Treatment Areas



Peak Flows

Stream response to storms and runoff is generally measured in terms of increased water flow volume and velocity. Precipitation and snowmelt increase stream flow until a peak is reached and stream flow declines toward ground-water supported levels. The speed and duration of stream response is a function of the size and drainage network configuration of the watershed, topographic and vegetative watershed characteristics, and storm/runoff event size and duration. Peak flows are categorized in terms of their return interval, that is, the highest expected flow for a specific time interval. The two year return interval generally determines basic stream morphology since it occurs regularly over the long term and thus distributes the bulk of the long term sediment load (Rosgen 1996).

Effects of Forest Practices on Peak Flows and Consequent Channel Response paper is a state-of-the-art synthesis of effects of forest harvest activities on peak flows and channel morphology in the Pacific Northwest (Grant et al 2008). The study reviewed peak flow data across rain, transient and snow dominated hydrologic zones. The paper provides guidance as to how to evaluate the potential risk of peak flows for specific management treatments employed.

For basins within the transitional snow hydrologic zone, Grant et al. found that the detection threshold for changes in peak flows occurs at 20% of watershed area clear cut or regeneration harvested. Thus, changes in peak flows cannot be detected at harvest levels of less than 20% (Grant et al 2008). Based on the hydroregions developed by Grant et al., the Upper Briggs project area would be located in the transitional hydroregion. Based on the detection threshold for changes in peak flows occurring at 20% of watershed area harvested, changes in peak flows cannot be detected at harvest levels of less than 20%. The study **examined clear-cuts** and **shelter wood harvests**. The Upper Briggs project proposes approximately 16% of the watershed for thinning treatments (Table 11).

Table 11: Alternative 2 Percent Thinning of Watershed

6th field Project Area Watershed	Acres	Acres of Proposed Treatments	% in Watershed
Upper Briggs Creek (171003110701)	24,645	4,017	**16 %**

Again, the existing studies examined were for clear-cut and shelter-wood harvests. Thus, evaluating this type of treatment would interpret the maximum likely effects and exceeds the potential effects for the thinning treatments proposed in the Upper Briggs Project. Gordon et al. also concludes that partial cutting and thinning should result in peak flow changes that are commensurately lower than those indicated and may be undetectable in some basins (Grant et al. 2008). For thinning treatments with riparian buffers the study finds a low likelihood of peak flow increase.

Considering the low likelihood of peak flow increases from thinning and the proposed area for treatment is below 20% threshold for detecting increases in peak flow from clear-cut harvest, there will be no increase in peak flow from the proposed thinning.

An identified information gap in current studies is that road effects are not separated from harvest effects since these activities generally occur together or with only a brief delay. It is generally accepted that roads increase peak flows if they are hydrologically connected to streams; conversely, stream buffers and road rehabilitation decrease hydrologic connectivity and the peak flow effect of roads.

No new system roads are proposed for the Upper Briggs Creek project. There will be no increase in FS system road miles that could affect peak flow. The project is proposing ~ 3 miles of temporary roads under Alternative 2 that will be decommissioned and the natural drainage pattern restored after they are no longer needed for the thinning treatment.

Cumulative Effects

Cumulative effects are those that result from the incremental accumulations of all land management activities across all ownerships. Cumulative effects for the project area encompass the entire Upper Briggs Creek 6th field watershed (24,645 acres). Past activities are considered part of the existing condition. To understand the contribution of past actions to the cumulative effects of the proposed action, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment, and might contribute to future cumulative effects.

The concept of hydrologic recovery is commonly applied to assess cumulative effects. By assessing the percent of watershed with young stands, or stands less than 30 years old, the relative risk of adverse cumulative effects of the watershed can be identified. If less than 15 percent of the watershed is young stands, the watershed risk is considered low. If 15 to 30 percent of the watershed is young stands, there is a moderate risk, and there is a high risk if greater than 30 percent of the watershed is comprised of young stands (USDA Forest Service 1993).

Past Activities

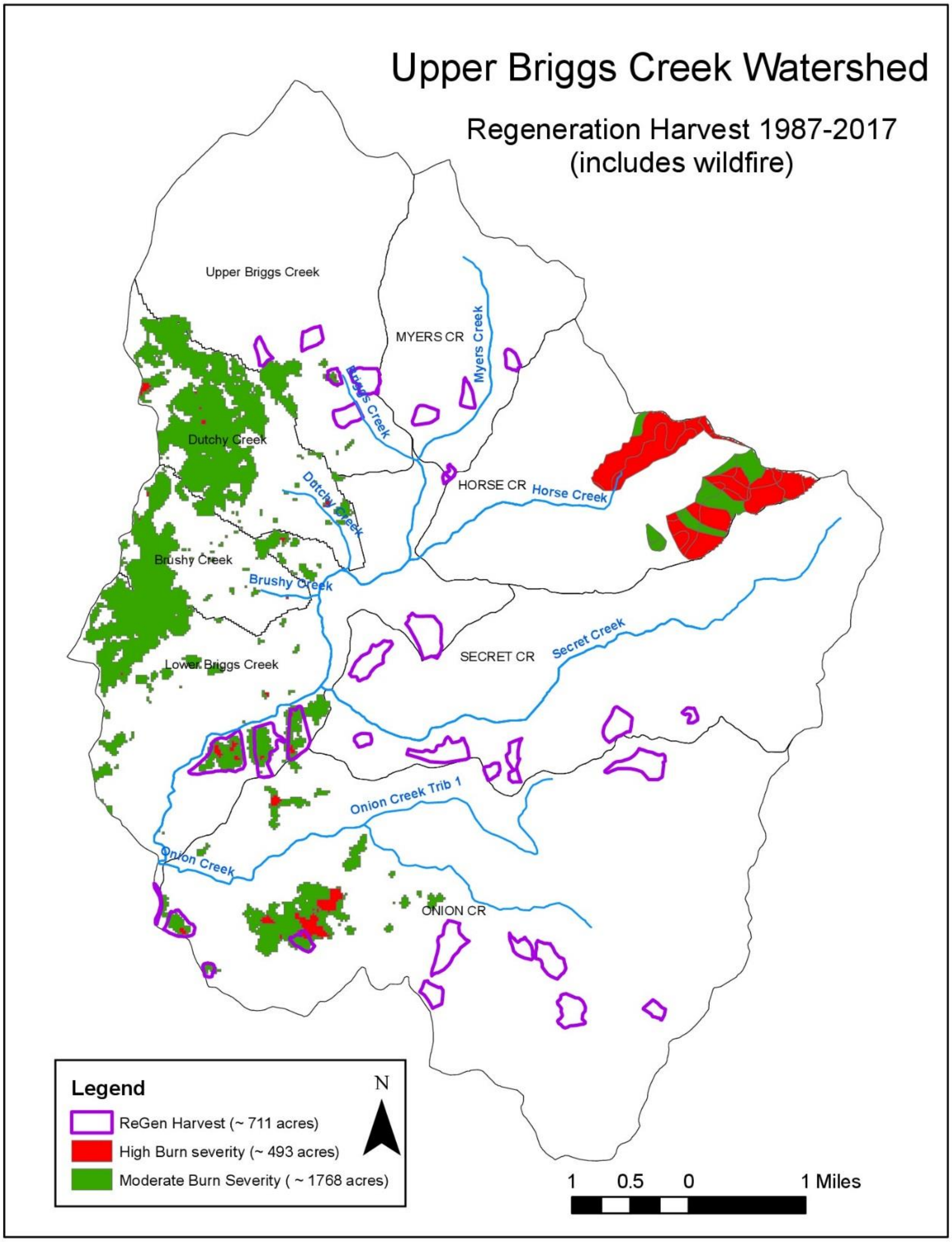
The proposed action to treat 4,017 acres (Alternative 2) would have no effect on cumulative effects because approximately 12% of the planning area (Figure 11) has stands less than 30 years old, therefore there is currently a low cumulative watershed risk in terms of hydrologic recovery (USDA 1993). There are 11 tax lots owned by 5 private entities within the planning area. 4 of these holdings are owned by limited corporation holdings. The corporations are likely forest product companies. One is the old Bar Mine a private in holding, which is a patented placer mine owned by a private landowner. The landowner has a wash plant and heavy equipment. Approximately 1.2 miles of roads are in place on private land holdings.

Current/Ongoing and Reasonably Foreseeable Activities in the planning area

There are mining activities (89 active placer claims) currently occurring on Forest Service-managed lands in the Upper Briggs Creek Watershed. Other future activities planned on Forest Service managed lands include tree planting (121 acres), road decommissioning (11.1 miles of ML1 roads) and 1.6 miles of road to ML1, various fuels treatment projects, road and trail maintenance, noxious weed control and stream crossing improvement at four road crossings. None of these activities would create new young stands. The placer mine has not operated for several years. It is reasonable to infer that current actions and road use occurring on private lands will continue.

No predictable effects are expected to occur to the streams within the project area or downstream. There would be no increase in negative cumulative effects when combined with activities presently occurring or planned for the foreseeable future. Overall the streams within the watershed would be considered hydrologically recovered from past timber harvest.

Figure 11: Upper Briggs Creek Watershed Regeneration Harvest 1987-2017



Alternative 3

There are 2,628 acres within the proposed vegetation treatment units in Alternative 3 compared to 4,017 acres in Alternative 2 (Table 12). This includes all of the primary management objectives (develop and enhance late seral habitat (DELSH), restore pine-oak communities, restore sensitive plant habitat, restore meadow systems, restore riparian reserves, and create and maintain strategically located fuel management zones (FMZs)). Treatments would involve multiple silvicultural prescriptions, including variable density thinning to 60 or 40% canopy cover, thinning from below to maintain 60% canopy cover, hardwood retention, and ¾ acre maximum patch cuts. Fuels treatments would involve pruning, piling, and burning post vegetation treatment, with underburning 1 to 5 years post treatment. Treatment methods would involve a combination of manual (hand) work, and mechanized equipment including ground-based, cable-yarding, and helicopter equipment. It is estimated that less than 0.61 miles of temporary roads would be needed to provide temporary access to meet project objectives.

Table 12. Treatment Objective and Proposed Acres Treated for Alternative 2 and Alternative 3

Primary Treatment Objective	Alternative 2 Acres Treated	Alt 2 % Watershed	Alternative 3 Acres Treated	Alt3 % Watershed
DELSH	1053	4%	556	2%
Riparian Restoration	183	<1%	128	<1%
Roadside FMZ	713	3%	794	3%
Pine Oak	706	3%	479	2%
Rare Plants	42	<1%	42	<1%
Meadow Restoration	188	<1%	126	<1%
Ridgeline FMZ	1132	4%	503	2%
Total Acres	**4017**	**16%**	**2628**	**11%**

Water Quality

Stream Temperature

Temporary Road Construction

There is no new road construction proposed in this project. There would be a maximum of 3,221 feet (~ 0.61 mile) of temporary road construction. Temporary roads would be defined as a created travel way, for the purpose of transporting logs that is built, utilized, and decommissioned (obliterated) over the course of the treatment. Obliteration of these roads would occur at the completion of their intended use. Temporary roads would only include reconstruction of existing (Unclassified) roads where there is an existing road template. These temporary roads would be located near ridgelines. In addition, the temporary roads would not be located within Riparian Reserves or within 100 feet of ephemeral streams. Therefore, there is no loss of vegetation within the primary shade zone and no effect to stream temperature from temporary roads. No sediment from temporary road construction will affect stream channel morphology of perennial, intermittent, or ephemeral streams (See Coarse Sediment section). Thus, no increase in stream temperature would occur from channel widening due to temporary roads.

Prescribed Burning Activities

Fuels treatment in Riparian Reserves would be accomplished by manual thinning and backing prescribed fire into the riparian area. Ignition points would not occur closer than 120 feet from perennial streams. In addition, no hand piles would be burned within 120 feet of a stream (Appendix A).

Similar treatments were implemented on the Forest for the 1995 Waters Thin Hazardous Fuels Reduction Project (Waters Thin Project). For this project, monitoring sites were established to determine if there were any changes in the stream channel or shade as a result of the thinning and fuels treatment. The monitoring sites were established to validate the findings in the 1995 Waters Thin Hydrology Cumulative Effects Analysis that concluded there would not be a significant risk to the integrity of the aquatic system if the treatments occurred. Sites were monitored before thinning and fuels treatment began. Monitoring included measuring stream shade using a solar pathfinder and tracking channel changes using photo points. This baseline data was then compared to data collected in 2005 after treatment and several winter storms including the 1997 storm that was a 50-year event (Park and Jubas 2005).

Based on monitoring results of past prescribed fire treatments in the Waters Thin Project (Park and Jubas 2005), fire in Riparian Reserves for the Upper Briggs Creek Project would be a low intensity ground burn stopping at least 120 feet from the stream. In addition, no primary shade zone overstory riparian canopy (Table 6) would be affected by the prescribed burning activities. Therefore, there would be no increase in stream temperature from prescribed burning.

Water Quality

Fine Sediment and Turbidity (Suspended Sediment)

Temporary Road Construction

There is no new road construction proposed in this project. There would be a maximum of 3,221 feet (~ 0.61 mile) of temporary road construction. Temporary roads would be defined as a created travel way, for the purpose of transporting logs that is built, utilized, and decommissioned (obliterated) over the course of the treatment. Obliteration of these roads would occur at the completion of their intended use. Temporary roads would only include reconstruction of existing (Unclassified) roads where there is an existing road template. These temporary roads would be located near ridgelines. In addition, the temporary roads would not be located within Riparian Reserves or within 100 feet of ephemeral streams. No sediment from temporary road construction will affect stream channel morphology of perennial, intermittent, or ephemeral streams.

Prescribed Burning Activities

Fuels treatment in riparian areas will be accomplished by manual thinning and then backing prescribed fire into Riparian Reserves to reduce fuels. Monitoring results of past prescribed fire activities in the 1995 Waters Thin Project show that the fire will be a low intensity ground burn, stopping at least **120 feet** from the stream. No surface erosion, that could deliver fine sediment to a stream, has been detected in the monitoring of that project (Park and Jubas 2005). Based on the similarity in treatments between the Waters Thin Project and the Proposed Project, no effects from fine sediment as a result of prescribed burning would be expected.

Even with some loss of short term infiltration associated with moderate and high intensity wildfires burns, it is rare to observe overland flow and surface erosion on the Rogue River-Siskiyou National Forest-managed lands. Turbidity was monitored following the 1987 Silver Fire and subsequent salvage logging. A summary of the data concluded, "There have been no noticeable effects in increases in turbidity or sediment" and "Turbidity does not appear to be a significant area of concern" (Kormeier, 1995). In addition, after the Biscuit wildfire in 2002, no changes in turbidity were observed or monitored following the first winter (Jubas 2005). Thus, since prescribed burning activities are less disturbing than wildfire burns, prescribed fire (as implemented according to PDCs in Appendix A) in Riparian Reserves would not cause fine sediment to be delivered to streams. Therefore, there would be no resulting increase in turbidity.

Riparian Reserves - Vegetation

Variable Density Thinning

Variable density thinning (VDT) is proposed in both managed stands and natural stands. These stands are primarily even-aged or two aged. Single storied plantations or even-aged as the result of fire disturbance. These stands are dominated by Douglas-fir. This treatment aims to enhance structural and species diversity, and result in a stand containing a variety of stand densities for development into late-successional conditions to meet Aquatic Conservation Strategies (USDA, USDI 1994). The desired variability and structural complexity from this treatment is explained under *Density Management* (see silviculture specialist report). Treatments would retain at least 60 percent canopy cover and other habitat features in both dispersal and NRF habitat. Management scenarios would differ by harvest system. Stands that would maintain at least 60 percent canopy cover where helicopter yarding is proposed would see gap-only treatments ranging in size from 1/5 to ¾ acre. Stands in upland riparian reserves would maintain at least 60 percent canopy cover in NRF and dispersal habitat. Treatments would retain components of understory and intermediate trees for complex structural development. Thinning would be distributed across canopy layers and tree classes, create canopy gaps, and vary in tree sizes and species.

A total of 451 acres is proposed for riparian reserve treatment. Meyers Creek subwatershed will have the largest number of riparian acres treated or 141 acres followed by Horse Creek at 133 acres. Overall, 6.7% of riparian reserves in the Project area will be treated as shown in Table 13, Table 14 and Figure 12.

Table 13: Alternative 3 – Proposed Treatment Summary in Riparian Reserves

Subwatershed	Riparian Reserves (acres)	Treatment in Riparian Reserves (acres)	Percent of Riparian Reserve Treatments in each subwatershed
Brushy Creek	192	0	0
Dutchy Creek	364	8	2.2 %
Horse Creek	770	133	17 %
Lower Briggs Creek	969	55	5.7 %
Meyers Creek	672	141	21 %
Upper Briggs Creek	735	7	1.0 %
Onion Creek	1926	14	0.7 %
Secret Creek	1086	93	8.6 %
Overall Total (Project Area HUC 6)	6714	451	6.7 %

Thinning within and outside of Riparian Reserves and Prescribed Burning Activities

The perennial portions of the Riparian Reserves proposed for thinning and prescribed burning have been harvested in the past. Since much of the project area has been harvested, there is a shortage of large wood for recruitment. Thinning would increase tree growth and lessen the time needed to establish future large wood delivery. Both thinning and fuels treatment would lower the likelihood of a stand replacement fire in the overstocked Riparian Reserves.

Corridors for cable rigging needed for skyline operations would be allowed to pass through Riparian Reserves. A maximum clearing width of 12 feet is required and logs may be yarded through these perennial corridors. Corridors are required to be spaced at a minimum of 200 feet apart. If skyline operations occur through Riparian Reserves, vegetation would be impacted by this clearing and subsequent yarding. Loss of vegetation through these areas would occur. Corridor "rub trees" would be left on site if impacted or felled.

By implementing PDCs (Appendix A and B), the Northwest Forest Plan Temperature TMDL Implementation Strategies (Table 6) and BMPs (USDA 1988 and 2012), impacts to riparian vegetation would be minimal. No timber harvest or fuels treatments would be allowed within 120 feet of streams. Since most of the riparian areas on streams with the project area are located within 25 feet of the stream channel, the riparian vegetation would not be impacted by the proposed treatments.

Stand Examination data collected in 2008, 2011 and 2015 were used in the FSVeg Spatial Data Analyzer to perform a robust statistical analyses for desired future conditions (see Silvicultural Specialist Report). Riparian Reserve Stand summaries are listed below with desired future conditions set for 40 years which will include commercial thinning, fuels thinning, punning, piling, pile burn and under burns. Modeling results show Riparian Stands would maintain the proposed desired condition of 60% canopy cover (Table 15).

Table 14: Riparian Treatment Acres in Alternative 3 Proposed Units

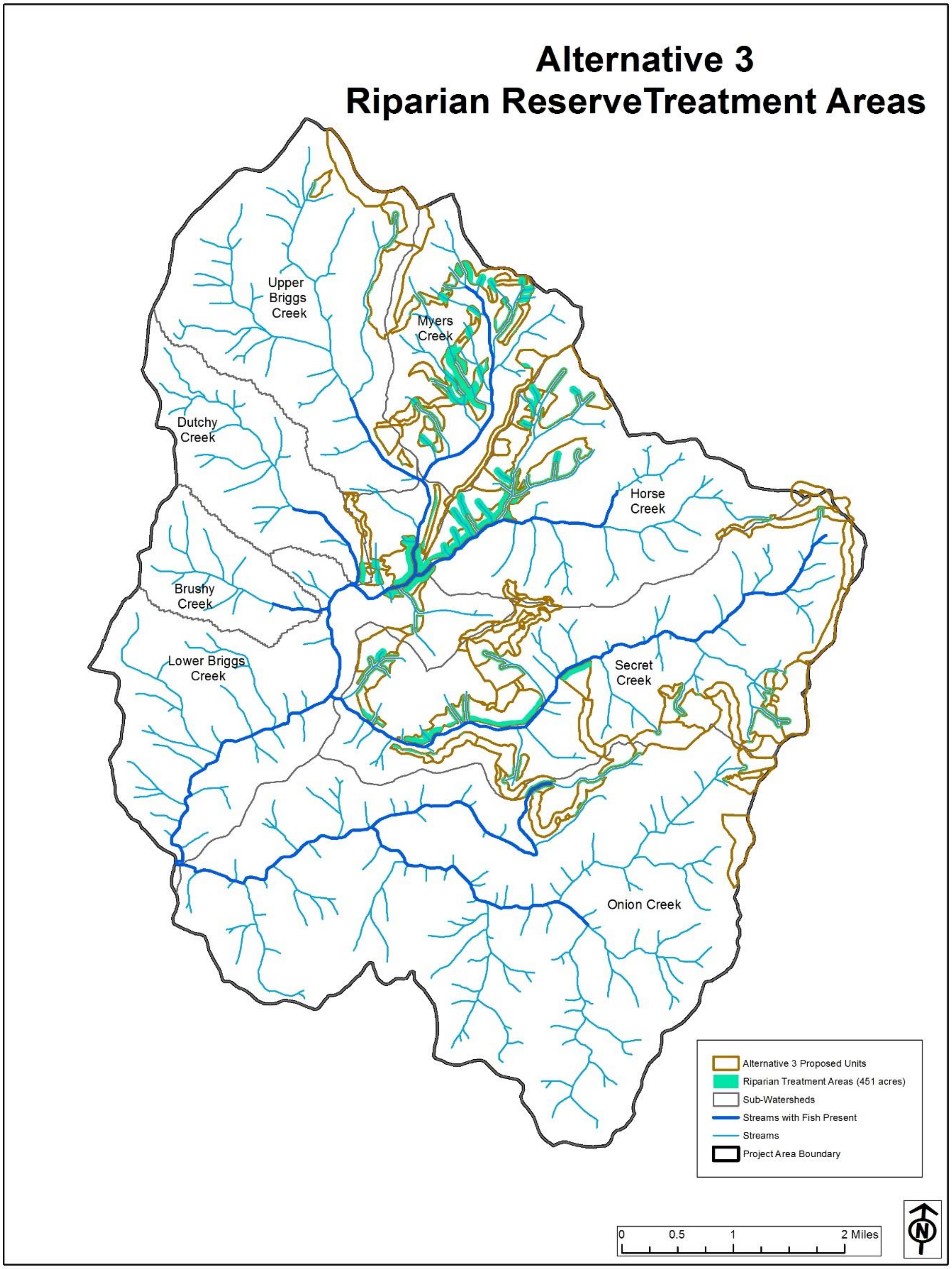
Unit No.	Primary Objective Alternative 3	NO CUT 0 – 120 feet	Treatment Acres adjacent to Perennial (from 120-360 feet)	Treatment Acres adjacent to Intermittent (from 120-180 feet)
1	FMZ			0.6
2	DELSH		7.2	5.9
3	Pine Oak/rare		1.1	44.3
3S	Rare Plants		3.1	8.3
4	DELSH		0.4	3.4
5	DELSH			5.8
8	DELSH			5.1
9	DELSH			4.5
10	Pine Oak			15.8
11	Meadow			0.9
12	DELSH		0.7	
32	Pine Oak			12.9
36	DELSH			1.5
38	FMZ			2.6
39	Pine Oak			1.7
43	FMZ			2.7
47	FMZ			0.4
48	Meadow		26.8	23.0
50	Meadow		36.1	8.7
51	DELSH			2.3
57	FMZ			1.1
59	DELSH			0.9
61	FMZ/DELSH			0.4
63	Riparian		32.5	10.5
64	DELSH			3.4
67	FMZ			4.7
69	DELSH			1.8
71	DELSH			0.9
80	DELSH		8.5	0.5
102	Pine Oak			2.8
104	Riparian			1.2
118	FMZ			0.2
165	DELSH		5.1	4.4
240	DELSH		1.2	6.1
253	DELSH		1.6	
262	DELSH		29.4	12.8
500	Roadside FMZ		8.7	20.0
501	Roadside FMZ			8.0
502	Roadside FMZ		0.7	

503	Roadside FMZ		1.1	7.3
504	Roadside FMZ			3.3
505	Roadside FMZ			6.6
506	Roadside FMZ			0.1
507	Roadside FMZ		4.6	
509	Roadside FMZ			3.3
510	Roadside FMZ		4.1	1.7
511	Roadside FMZ			0.2
513	Roadside FMZ		3.3	11.2
516	Roadside FMZ			2.5
517	Roadside FMZ			3.0
652	DELSH			5.8
SUBTOTAL			**176 acres**	**275 acres**
TOTAL	**451 acres**			

Table 15: Silvicultural Modeling Results for Riparian Stands

Year	Average Uniform Canopy Cover (%)	Average Tree Top Height (ft)
2017	86	108.4
2018	82	106.4
2022	80.5	110.2
2027	80.8	114.3
2037	81.7	123.4
2047	82	131.7
2057	82	139.3

Figure 12: Alternative 3 Riparian Reserve Treatment Areas



Peak Flows

Stream response to storms and runoff is generally measured in terms of increased water flow volume and velocity. Precipitation and snowmelt increase stream flow until a peak is reached and stream flow declines toward ground-water supported levels. The speed and duration of stream response is a function of the size and drainage network configuration of the watershed, topographic and vegetative watershed characteristics, and storm/runoff event size and duration. Peak flows are categorized in terms of their return interval, that is, the highest expected flow for a specific time interval. The two year return interval generally determines basic stream morphology since it occurs regularly over the long term and thus distributes the bulk of the long term sediment load (Rosgen 1996).

Effects of Forest Practices on Peak Flows and Consequent Channel Response paper is a state-of-the-art synthesis of effects of forest harvest activities on peak flows and channel morphology in the Pacific Northwest (Grant et al 2008). The study reviewed peak flow data across rain, transient and snow dominated hydrologic zones. The paper provides guidance as to how to evaluate the potential risk of peak flows for specific management treatments employed.

For basins within the transitional snow hydrologic zone, Grant et al. found that the detection threshold for changes in peak flows occurs at 20% of watershed area clear cut or regeneration harvested. Thus, changes in peak flows cannot be detected at harvest levels of less than 20% (Grant et al 2008). Based on the hydroregions developed by Grant et al., the project area would be located in the transitional hydroregion. Based on the detection threshold for changes in peak flows occurring at 20% of watershed area harvested, changes in peak flows cannot be detected at harvest levels of less than 20%. The study examined clear-cuts and shelter wood harvests.

The Upper Briggs project proposes approximately 11% of the watershed for thinning treatments (Table 16).

Table 16: Alternative 3 Percent Thinning of Watershed

6th field Project Area Watershed	Acres	Acres proposed treatments (Alt 3)	% in Watershed
Upper Briggs Creek (171003110701)	24,645	2,628	**11%**

The existing studies examined were for clear-cut and shelter-wood harvests. Thus, evaluating this type of treatment would interpret the maximum likely effects and exceeds the potential effects for the thinning treatments proposed in the Upper Briggs Project. Gordon et al. also concludes that partial cutting and thinning should result in peak flow changes that are commensurately lower than those indicated and may be undetectable in some basins (Grant et al. 2008). For thinning treatments with riparian buffers the study finds a low likelihood of peak flow increase.

Considering the low likelihood of peak flow increases from thinning and the proposed area for treatment is below 20% threshold for detecting increases in peak flow from clear-cut harvest, there will be no increase in peak flow from the proposed thinning.

No new system roads are proposed for the Upper Briggs Creek project. There will be no increase in system road miles that could affect peak flow. The project is proposing ~ 0.61 miles of temporary roads that will be decommissioned and the natural drainage pattern restored after they are no longer needed for the thinning treatment.

Cumulative Effects

Cumulative effects are those that result from the incremental accumulations of all land management activities across all ownerships. Cumulative effects for the project area encompass the entire Upper Briggs Creek 6th field watershed (24,645 acres). Past activities are considered part of the existing condition. To understand the contribution of past actions to the cumulative effects of the proposed action, this analysis relies on current environmental conditions as a proxy for the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment, and might contribute to future cumulative effects.

The concept of hydrologic recovery is commonly applied to assess cumulative effects. By assessing the percent of watershed with young stands, or stands less than 30 years old, the relative risk of adverse cumulative effects of the watershed can be identified. If less than 15 percent of the watershed is young stands, the watershed risk is considered low. If 15 to 30 percent of the watershed is young stands, there is a moderate risk, and there is a high risk if greater than 30 percent of the watershed is comprised of young stands (USDA Forest Service 1993).

Past Activities

The proposed action to treat 2,628 acres (Alternative 3) would have no effect on cumulative effects because approximately 12% of the planning area (Figure 11) has stands less than 30 years old, therefore there is currently a low cumulative watershed risk in terms of hydrologic recovery (USDA 1993). There are 11 tax lots owned by 5 private entities within the planning area. 4 of these holdings are owned by limited corporation holdings. The corporations are likely forest product companies. One is the old Bar Mine a private in holding, which is a patented placer mine owned by a private landowner. The landowner has a wash plant and heavy equipment. Approximately 1.2 miles of roads are in place on private land holdings.

Current/Ongoing and Reasonably Foreseeable Activities in the planning area

There are mining activities (89 active placer claims) currently occurring on Forest Service-managed lands in the Upper Briggs Creek Watershed. Other future activities planned on Forest Service managed lands include tree planting (~ 121 acres), road decommissioning (11.1 miles of ML1 roads) and 1.6 miles of road to ML1, various fuels treatment projects, road and trail maintenance, noxious weed control and stream crossing improvement at four road crossings. None of these activities would create new young stands. The placer mine has not operated for several years. It is reasonable to infer that current actions and road use occurring on private lands will continue.
No predictable effects are expected to occur to the streams within the project area or downstream. There would be no increase in negative cumulative effects when combined with activities

presently occurring or planned for the foreseeable future. Overall the streams within the watershed would be considered hydrologically recovered from past timber harvest.

Compliance with the Aquatic Conservation Strategy Objectives provided by the Northwest Forest Plan

In order for a project to proceed, "a decision maker must find that the proposed management activity is consistent with the Aquatic Conservation Strategy objectives" (USDA and USDI, 1994). The nine objectives are listed on page B-11 of the Record of Decision (ROD). Portions of the effects analysis in this document focus on key parameters or indicators that make up elements of the nine Aquatic Conservation Strategy objectives, to determine if the project would restore, maintain, or degrade these indicators. Once this determination is made, the indicators are examined together with the Range of Natural Variability to ascertain whether the project is consistent with the objectives. The following table displays specific indicators that comprise the Aquatic Conservation Strategy objectives and the effects section that covers this indicator in the EA.

Indicators	Analysis Found in the Effects Section of the EA
Water Temperature	Water Quality
Sediment	Soils, Water Quality, Fisheries
Chemical Contamination	Water Quality, Fisheries
Physical Barriers	Water Quality, Fisheries
Substrate	Fisheries
Large Woody Debris	Fisheries
Pool Frequency	Fisheries
Pool Quality	Fisheries
Off-Channel Habitat	Fisheries
Refugia	Fisheries
Width/Depth Ratio	Fisheries
Streambank Condition	Water Quality, Fisheries
Floodplain Connectivity	Water Quality, Fisheries
Peak/base Flows	Water Quality
Drainage Network Increase	Water Quality
Riparian Reserves	Water Quality, Fisheries

As stated above, a description of the range of natural variability of the “important physical and biological components” (USDA and USDI 1994) is necessary for determining whether a project “meets” or “does not prevent attainment” of the Aquatic Conservation Strategy objectives. Historically, in the Upper Briggs Creek Project area, sediment input to streams appears to have been more episodic than continual. Rain-on-snow events could result in high levels of erosion and rockfall on steeper slopes in the Transition Zones. High intensity rainstorms shortly after a high severity stand-replacing fire could also generate large sediment input. In general, natural sediment input tends to be episodic in nature and large pulses are associated with natural disturbances such as floods and fires.

The following table displays the individual indicators and the effect the action alternatives have on those indicators at the 5^{th}, 6^{th} and 7^{th} field watershed scale. Fifth field watersheds are generally large in size (40,000 acres to 250,000 acres), while 6^{th} and 7^{th} field watersheds are smaller (5,000 acres to 40,000 acres and 2,000 acres to 5,000 acres respectively).

Indicators	No Action: Restore [1]	No Action: Maintain [2]	No Action: Degrade [3]	Alternative 2: Restore	Alternative 2: Maintain	Alternative 2: Degrade	Alternative 3: Restore	Alternative 3: Maintain	Alternative 3: Degrade
Water Quality Temperature		X			X			X	
Sediment		X			X			X	
Chemical Contamination		X			X			X	
Habitat Access Physical Barriers		X			X			X	
Habitat Elements Substrate		X			X			X	
Large Woody Debris		X			X			X	
Pool Frequency		X			X			X	
Pool Quality		X			X			X	
Off-channel Habitat		X			X			X	
Refugia		X			X			X	
Channel Conditions and Dynamics: Width/Depth Ratio		X			X			X	
Streambank Condition		X			X			X	
Floodplain Connectivity		X			X			X	
Flow/Hydrology Peak/Base Flows		X			X			X	
Drainage Network Increase		X			X			X	
Watershed Conditions Riparian Reserves		X		X (slight improvement)			X (slight improvement)		

Effects of the Actions

[1]"Restore" means the action(s) would result in acceleration of the recovery rate of that indicator.

[2]"Maintain" means that the function of an indicator does not change by implementing the action(s) or recovery would continue at its current rate.

[3]"Degrade" means changing the function of an indicator for the worse.

The following is a summary the Aquatic Conservation Strategy objectives (ROD B-10) and how the action alternatives would influence them:

Objective #1: Maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations and communities are uniquely adapted.

The project would maintain and restore the distribution, diversity, and complexity of watershed and landscape-scale features to ensure protection of the aquatic systems to which species, populations, and communities are uniquely adapted. The Action Alternatives are expected to have no effect on aquatic resources. For both Alternatives a connected action will include temporary roads. Best Management Practices pertaining to drainage and location, and field review during implementation will be an effective means for eliminating localized impacts such as site erosion of flow modification. Logging systems will employ extensive Project Design Criteria and Mitigation Measures. Wildfire protection would also be improved through management of fuel levels and distribution, reducing the severity of effects on watershed vegetation and soils. No new road crossings of streams or wetlands are proposed.
All of the Action Alternatives would have an undetectable effect with a long-term beneficial effect on the watershed and landscape-scale features.

Objective #2: Maintain and restore spatial and temporal connectivity within and between watersheds. Lateral, longitudinal, and drainage network connections include floodplains, wetlands, upslope areas, headwater tributaries, and intact refugia. These network connections must provide chemically and physically unobstructed routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species.

No activities included in any of the Action Alternatives would sever existing linkages (movement conduits) between watersheds or permanently obstruct existing connections in the drainage network. Thinning and prescribed burning treatments would be designed to improve stand structure and composition. Logging systems will employ extensive Project Design Criteria and Mitigation Measures. All temporary roads in the Proposed Action Alternatives will be developed outside of Riparian Reserves and decommissioned after use. No new road crossings of streams or wetlands are proposed. Finally, none of the activities or results proposed would chemically or physically impede routes to areas critical for fulfilling life history requirements of aquatic and riparian-dependent species, especially native fish species. None of the Action Alternatives would have an effect on network connections and or create any physical obstructions.

Objective #3: Maintain and restore the physical integrity of the aquatic system, including shorelines, banks, and bottom configurations.

This project would meet this objective through mitigation measures, design criteria and the protection provided by Riparian Reserves. Mitigation measures and design criteria aimed at reducing soil compaction and erosion, establishment of undisturbed vegetative buffers next to all stream networks, prescriptions for Riparian Reserves that are intended to maintain or enhance the development of a diverse, healthy riparian area and the lack of any new crossings on perennial streams would greatly reduce risks of sedimentation, increased peak flow, and resulting bank erosion and channel bed scour. Runoff/streamflow changes are not anticipated. Logging systems

and use of temporary roads for haul would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures.
Project would also maintain existing physical integrity of the aquatic system with restoration at specific locations (i.e. failed road/stream crossings; road decommissioning).

Objective 4: Maintain and restore water quality necessary to support healthy riparian, aquatic, and wetland ecosystems. Water quality must remain within the range that maintains the biological, physical, and chemical integrity of the system and benefits survival, growth, reproduction, and migration of individuals composing aquatic and riparian communities.

Thinning and prescribed burning treatments would improve the biological, physical and chemical integrity of the aquatic system. All action alternatives would maintain existing stream temperatures. Logging systems and use of temporary roads for haul would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures. Mitigation measures and design criteria aimed at reducing erosion are further discussed in detail in the soil section in Chapter 3. All alternatives would maintain water quality necessary to support healthy riparian and aquatic ecosystems because thinning and prescribed burning treatments would not prevent attainment of this objective and no temporary roads would be constructed within Riparian Reserves.

Objective #5. Maintain and restore the sediment regime under which aquatic ecosystems evolved. Elements of the sediment regime include the timing, volume, rate, and character of sediment input, storage, and transport. Project avoids direct contributions to stream sediment; contributes to long term soil protection by reducing severity of future wildfire behavior.

Proposed Action is sensitive to sediment that could be generated by the disturbance of steep slopes, unstable areas, and high gradient stream courses. The project avoids direct contribution to stream sediment and contributes to long term soil protection by reducing severity of future wildfire behavior. Logging systems have been selected to avoid soil damage on steep slopes and unstable areas are excluded from treatment. Logging systems and use of temporary roads for haul would employ extensive Project Design Criteria, Best Management Practices, and Mitigation Measures. Collectively, these measures ensure that the current sediment regime is maintained. These alternatives would have no measureable effect on the sediment regime.

Objective #6. Maintain and restore in-stream flows sufficient to create and sustain riparian, aquatic, and wetland habitats and to retain patterns of sediment, nutrient, and wood routing. The timing, magnitude, duration, and spatial distribution of peak, high, and low flows must be protected.

Project's effect on stream flow would be negligible; would not prevent attainment of this objective.

Objective #7. Maintain and restore the timing, variability, and duration of floodplain inundation and water table elevation in meadows and wetlands.

Project's effect on floodplain inundation and water tables would be negligible; would not prevent attainment of this objective.

Objective #8. Maintain and restore the species composition and structural diversity of plant communities in Riparian Reserves and wetlands to provide adequate summer and winter

thermal regulation, nutrient filtering, appropriate rates of surface erosion, bank erosion, and channel migration and to supply amounts and distributions of coarse woody debris sufficient to sustain physical complexity and stability.

The Action Alternatives are expected to maintain species composition and structural diversity of plant communities in the Riparian Reserves and wetlands. There would be some removal of vegetation associated with thinning, prescribed burning, and temporary road construction aimed at producing a more natural vegetative composition and density that has been lost through many decades of fire suppression.
No effects are anticipated that would affect species composition and structural diversity of plant communities within Riparian Reserves and wetlands.

Objective # 9. Maintain and restore habitat to support well-distributed populations of native plant, invertebrate, and vertebrate riparian-dependent species.

The project would meet this objective with mitigation measures, Project Design Criteria, Best Management Practices and vegetative treatments that are designed to simulate a more natural disturbance regime within the area. Refer to botany and wildlife reports.

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Appendix A

Project Design Elements for Riparian Reserves

Density management thinning treatments and/or commercial extraction should only be considered if needed to allow attainment of or restore Aquatic Conservation Strategy (ACS) objectives. Timber harvest is prohibited in Riparian Reserves, unless it is to acquire desired vegetation characteristics needed to attain ACS objectives or to mitigate damaging effects to Riparian Reserves from catastrophic events such as fire, flooding, volcanic, wind, or insect damage (NWFP Standards and Guidelines, Timber Management, TM-1). "Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives" (NWFP Standards and Guidelines, Timber Management, TM-1 c).

Situations in which timber harvest may be needed to attain ACS objectives include thinning in forested Riparian Reserves in order to improve shade and root strength, and other characteristics having to do with overall health and vigor of the stand. A young healthy stand has greater potential to provide shade within riparian areas and restore the timing, volume, rate, and character of sediment input and storage (water quality and aquatic habitat). A young healthy stand also has greater potential to grow into a late seral forest, providing late-successional habitat.

Overall Design Elements for Riparian Reserve Treatments

- Currently unmapped Riparian Reserves within the project area or within one site-potential tree (assumed to be 180 feet for all areas) of the project area boundary would be identified and included in riparian reserves during marking and unit layout and prior to implementation of treatments.
- No new temporary roads or landings, gap treatments, or heavy thinning is proposed nor allowed within Riparian Reserves without prior examination by a soils scientist or hydrologist to prescribe site specific mitigation, if needed (including relocation of the road).
- No density management would occur within 25 ft. of the stream channel.

Soil compaction or the loss of soil infiltration capacity in the riparian area from such things as skid roads could establish a mechanism for sediment delivery from concentrated overland flow. **As a special design element for this project, within 100 feet of a stream course, pre and post activity would not result in a loss of more than 10% of the soil infiltration capacity.** This element would include existing skid trails, which could be re-utilized as necessary and then be deep ripped (as feasible) to re-establish soil infiltration capacity. This figure does not include new haul roads or landings because they would be prohibited within Riparian Reserves.

To facilitate log suspension with skyline operations, corridors for cable rigging would be allowed to pass through Riparian Reserves. A maximum width of 12 ft. is required and logs may be yarded through this corridor if necessary. Corridors must be spaced at a minimum of 200 feet apart if they pass through Riparian Reserves. Corridor "rub trees" would be left, even if damaged and/or felled.

Riparian Reserve treatments and project design elements fall into three categories; (1) <u>fish-bearing perennial streams</u>, (2) <u>non-fish-bearing perennial streams</u>, and (3) <u>intermittent streams, wetlands and unstable areas</u>.

Category 1: Fish-bearing Perennial Streams

This category includes permanently flowing fish-bearing streams, typically Class I and II. The primary concern regarding treatments within this category is maintenance of stream temperature. Project design would follow direction provided in NWFP Temperature TMDL Implementation Strategies 2005[2]. This involves protection and maintenance of existing stream shade, and maintenance of the existing micro-climate, ambient air temperature, and air movement. For this Category, **Riparian Reserve widths** are two site potential tree heights each side of stream course (180 ft. X 2 = 360 ft. each side; total width 720 ft).

The **Stream Channel Protection Zone** is from the edge of stream course up to 25 feet. **No vegetation management** (including commercial extraction) **would occur within 25 ft. of the active stream channel**. No hand piles would be located or burned within the channel. Prescribed fire would not be ignited within this zone but fire may be allowed to "back down" to stream channel.

The **Primary Shade Zone** is an area where **no commercial extraction would occur** (larger trees felled for skyline corridor clearing would be left), however some density management, fuels reduction or other restoration treatments could occur. Distance from active stream channel varies according to height of existing overstory trees and hill slope in immediate area. For managed stands **trees that provide shade are assumed to be 60 ft and greater**. The following table establishes the width of the Primary Shade Zone.

Table 1. Minimum Width of Primary Shade Zone (feet), based on slope and Tree Height

Height of Tree	Hill slope < 30%	Hill slope 30% to 60%	Hill slope > 60%
Trees < 20 feet	12 feet	14 feet	15 feet
Trees 20 to 60 feet	28 feet	33 feet	55 feet
Trees > 60 to 100 feet	50 feet	55 feet	60 feet
Trees > 100 to 140 feet	70 feet	75 feet	85 feet

The Temperature Implementation Strategies allow the distances in above table to be less (but not less than 25 ft.) if any of the following conditions applies:

-The trees are located on a south facing slope (175-185 degree azimuth) and therefore do not provide stream shade;

-An appropriate level of analysis is completed and documented, such as shade modeling, using site-specific characteristics to determine the primary shade tree width; and or

-Field monitoring or measurements are completed to determine the width where optimum Angular Canopy Density (65% or greater) is achieved (see TMDL Implementation Strategies).

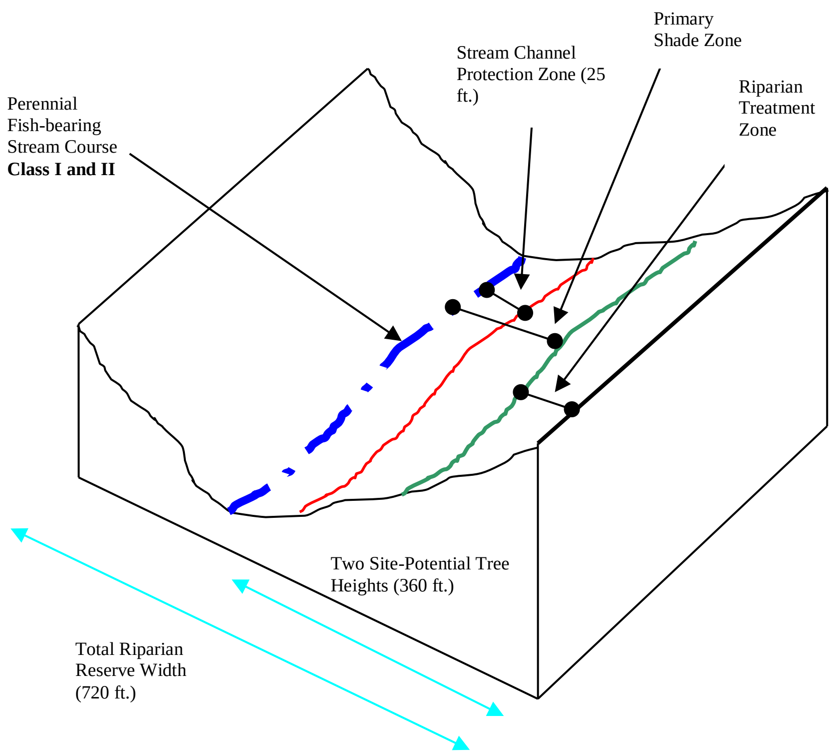
The **Riparian Treatment Zone** (Secondary Shade Zone) includes area from the edge of the Primary Shade Zone to the outer edge of the Riparian Reserve. Density management treatments and commercial extraction would be allowed, following guidelines and overall

[2] Northwest Forest Plan Temperature TMDL Implementation strategies - Evaluation of the Northwest Forest Plan Aquatic Conservation Strategy and Associated Tools to achieve and maintain stream temperature water quality standards. USFS and BLM; latest version September 9, 2005.

design elements for Riparian Reserve.

Within the Riparian Treatment Zone, the primary concern is prevention of sediment delivery to streams, prevention of concentrated overland flow, and maintenance of infiltration rates. **The maximum percent of area for detrimental soil conditions under the LRMP is 15% for an activity area (SNF LRMP S&G 7-2). This standard includes roads and landings. The 10 % soil infiltration capacity standard also applies, as noted above.**

Figure 1. Riparian Reserve Design Elements - Category 1



Category 2: Non Fish-bearing Perennial Streams

This category includes permanently flowing non fish-bearing streams, defined as Class III. The primary concern regarding treatments within this category also is maintenance of stream temperature. Project design would also follow direction provided in NWFP Temperature TMDL Implementation Strategies 2005. This involves protection and maintenance of existing stream shade, and maintenance of the existing micro-climate, ambient air temperature, and air movement.

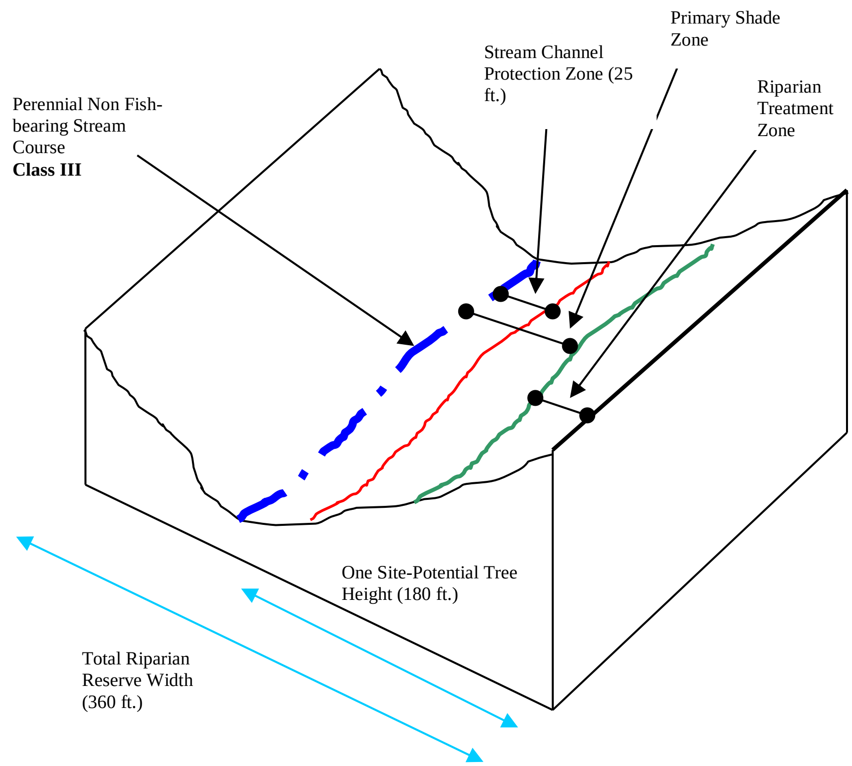
For this Category, **Riparian Reserve widths** are one site potential tree height each side of stream course (180 ft. each side; total width 360 ft.).

The **Stream Channel Protection Zone** is from the edge of stream course up to 25 feet. **No vegetation management** (including commercial extraction) **would occur within 25 ft. of the active stream channel**. No hand piles would be located or burned within the channel. Prescribed fire would not be ignited within this zone but fire may be allowed to "back down" to stream channel.

Under Category 2, the **Primary Shade Zone** is also an area where no commercial extraction would occur (larger trees felled for skyline corridor clearing would be left), however some density management or other restoration treatments could occur. Distance from active stream channel varies according to height of existing overstory trees and hill slope in immediate area. Table 1 (above) establishes the width of the Primary Shade Zone. The Temperature Implementation Strategies (discussed above) also allow the distances in above table to be less (but not less than 25 ft.) under the same conditions as under Category 1.

The **Riparian Treatment Zone** (Secondary Shade Zone) includes area from the edge of the Primary Shade Zone to the outer edge of the Riparian Reserve. Density management treatments and commercial extraction would be allowed, following guidelines and overall design elements for Riparian Reserve. The primary difference between Category 1 and 2 is the width of the entire Riparian Reserve (which is differentiated by fish-bearing status).

Figure 2. Riparian Reserve Design Elements - Category 2



Category 3: Non Fish-bearing Intermittent Streams and Wetlands

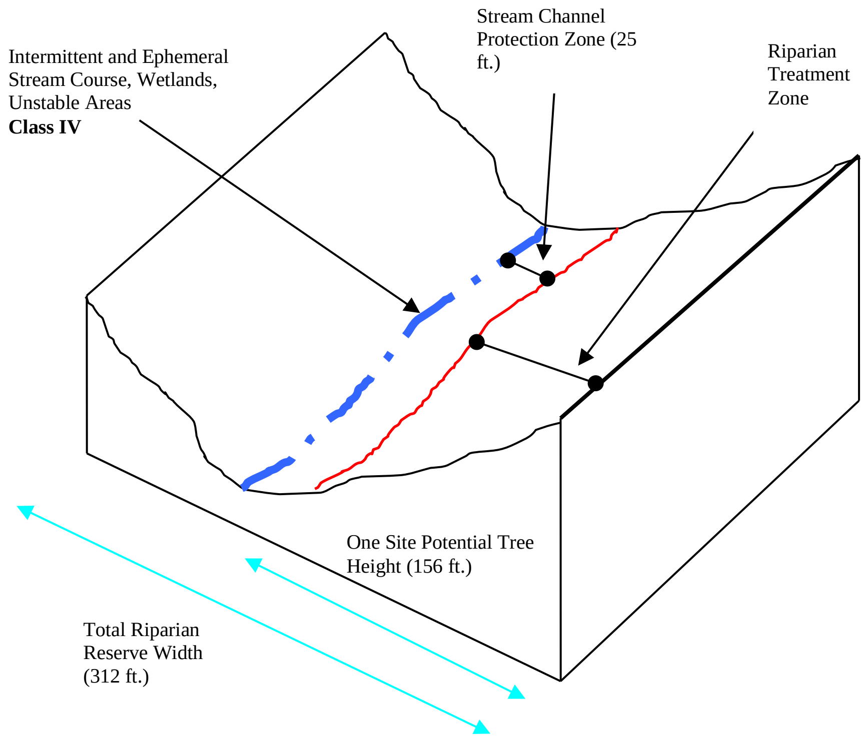
This category includes intermittent non-fish-bearing streams, typically Class IV, wetlands greater than one acre and unstable areas not associated with Class I, II and III streams. The primary concern is prevention of sediment delivery to streams, prevention of concentrated overland flow, and maintenance of micro-climates, ambient air temperature and humidity.

The **Stream Channel Protection Zone** is from the edge of stream course up to 25 feet. **No vegetation management** (including commercial extraction) **would occur within 25 ft. of the active stream channel**. No hand piles would be located or burned within the channel. Prescribed fire would not be ignited within this zone but fire may be allowed to "back down" to stream channel.

The **Riparian Treatment Zone** includes area from the edge of the Stream Channel Protection Zone, to the outer edge of the Riparian Reserve (one site potential tree height).

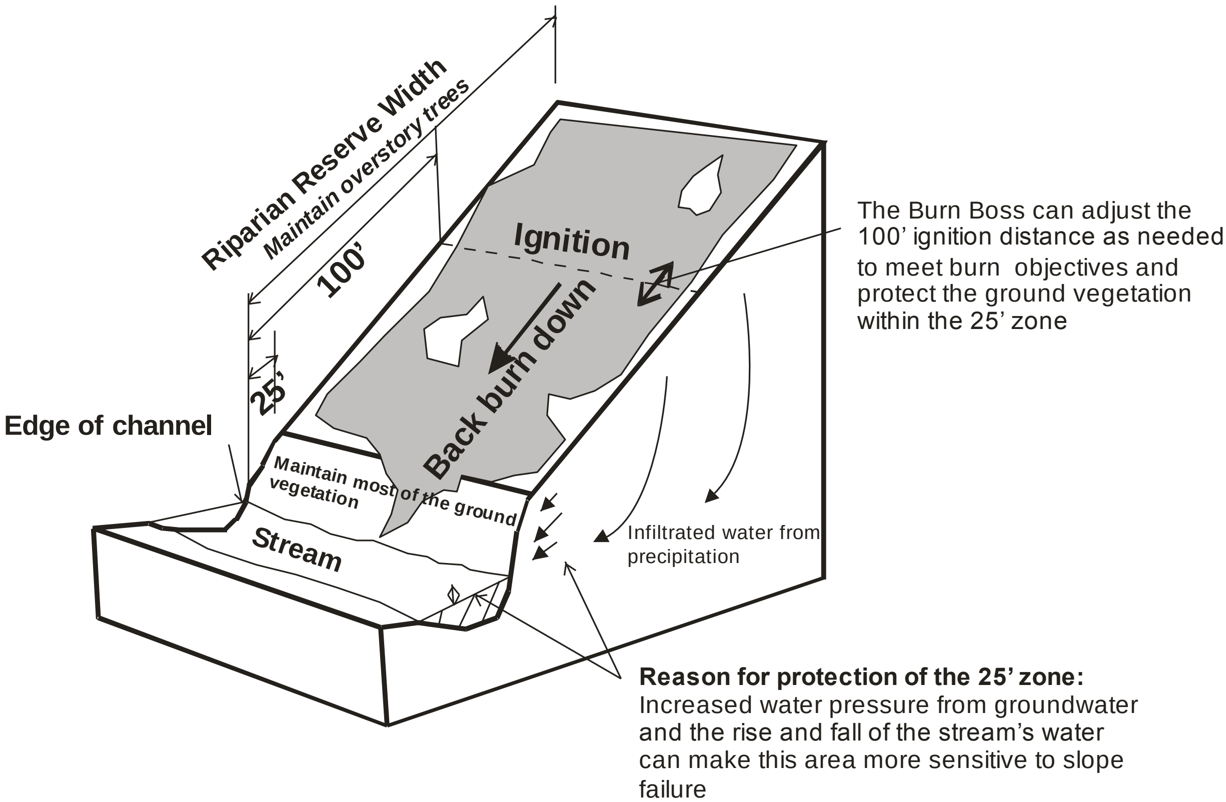
Density management treatments and commercial extraction would be allowed, following guidelines and design elements for Riparian Reserve.

Figure 3. Riparian Reserve Design Elements – Intermittent and Ephemeral – Category 3



Prescribed Burn in Riparian Reserves

Project Design Criteria

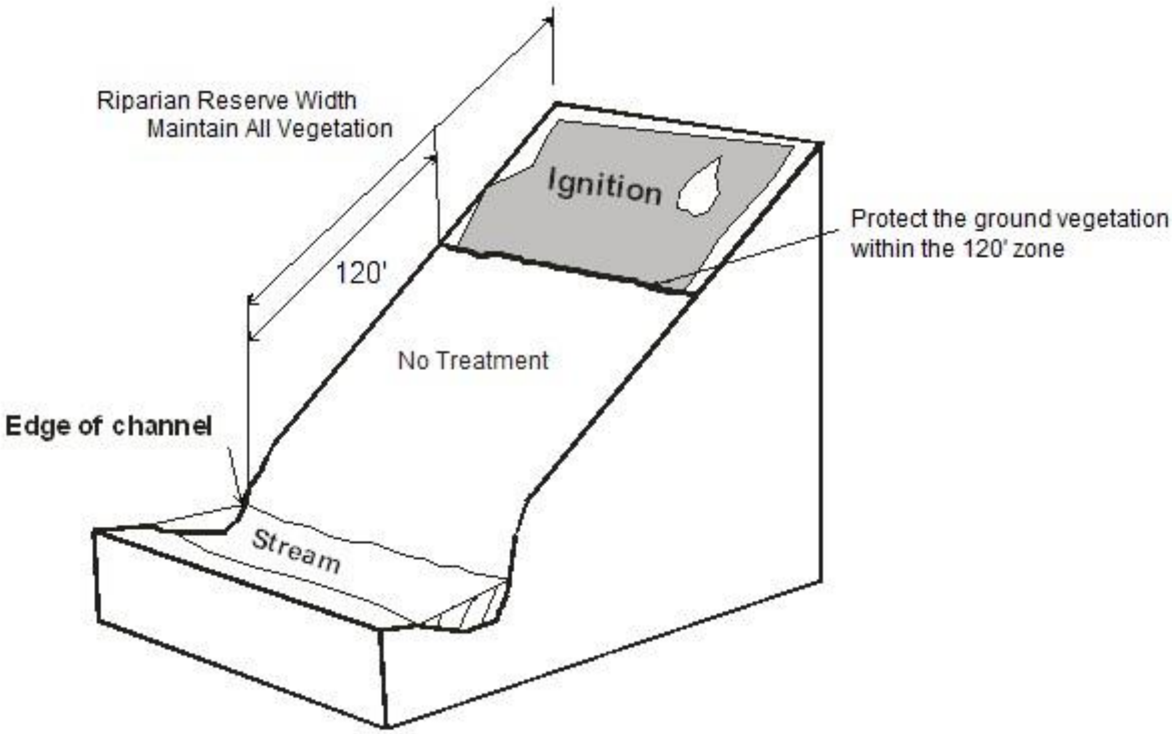


Reducing high fuel Loading - Use mechanical treatment and pile burning as needed prior to under burning to protect the overstory trees. Pile and burning should be no closer to the stream than 25' to maintain ground vegetation.

Pump chances - Fire, engineering and aquatic resource personnel will work together to determine suitable pump chances and the measures needed for the protection of aquatic resources. Refuel 100' feet from a stream or use measures to assure fuel does not reach flowing water. Water withdrawal equipment must have a 3/32 intake screen in order to avoid fish entrapment.

Prescribed Burn in Riparian Reserves

Project Design Criteria



Reducing high fuel Loading - Use mechanical treatment and pile burning as needed prior to under burning to protect the overstory trees. Pile and burning should be no closer to the stream than 120' to maintain ground vegetation.

Pump chances - Fire, engineering and aquatic resource personnel will work together to determine suitable pump chances and the measures needed for the protection of aquatic resources. Refuel 100' feet from a stream or use measures to assure fuel does not reach flowing water. Water withdrawal equipment must have a 3/32 intake screen in order to avoid fish entrapment.

Appendix B.

Thinning in Riparian Reserves
Within Over Stocked Managed Stands
Project Design Criteria and Supporting Rationale
Aquatics
Rogue River-Siskiyou National Forest
For Non-Meadow Streams

Riparian Reserve Direction: NWFP Standards and Guidelines, Timber Management, TM-1 c. Apply silvicultural practices for Riparian Reserves to control stocking, reestablish and manage stands, and acquire desired vegetation characteristics needed to attain Aquatic Conservation Strategy objectives (USDA 1994).

Table 1. Riparian Reserves Project Design Criteria

Type of Riparian Reserve	Mitigation	Resource Protection	Supporting Rationale
Fish-bearing and permanently flowing nonfish bearing streams	1. Apply direction in the Northwest Forest Plan **Temperature TMDL** Implementation Strategies table 3.	1. Maintain existing stream shade (primary shade zone).	Signed agreement between DEQ, BLM and FS to implement the Temperature Strategy, 2005
	2. During **fuels treatment** back down fire and do not burn ground vegetation within 25 feet of a stream (any slope, low intensity burn). No removal of understory vegetation within 25 feet. No ignition points within 100 feet.	2. Maintain bank integrity to prevent erosion during high flows.	Silver Fire Summary Kormeier, 1995, Biscuit Erosion Pin Study 2005, Water Thin Fuels Treatment Erosion Study 2006
	3. **Fuels treatment** - hand piles will not be burned closer than 25 feet from a stream	3. Maintain bank integrity to prevent erosion during high flows.	
	4. **Timber harvest** – No timber harvest as set by mitigation 1. From that distance to 100 feet of a stream use management practices that maintain 90% of pre-harvest infiltration rates. No harvest on unstable areas.	4. Prevent sediment delivery to stream and prevention of concentration of overland flow.	Silver Fire Summary Kormeier, Water Thin Fuels treatment erosion study 2006
			Evaluation of Non-Point Silviculture Sources, EPA 1980, Buffer Width Studies, Corbett et at. 1978, Lynch et al, 1985, Moring 1982
	5. **Large wood recruitment** – wood	5. Maintain and improve fish habitat complexity by recruitment of large wood material.	

Type of Riparian Reserve	Mitigation	Resource Protection	Supporting Rationale
	contribution zone need to be considered on a site specific basis.		
Intermittent Streams	2. During **fuels treatment,** minimize burning ground vegetation within 25 feet of a stream (any slope, low intensity burn). Minimize removal of understory vegetation within 25 feet. 3. **Fuels treatment** – No hand piles will be located or burned in the channel. Minimize hand pile burning closer than 25 feet from a stream. No ignition points within 100 feet. 4. **Timber harvest** – No timber harvest within 25 feet of a stream. From 25 to 100 feet of a stream use management practices that maintain 90% of pre-harvest infiltration rates. No harvest on unstable areas. 5. **Large wood recruitment** – wood contribution zone need to be considered on a site specific basis.	2. Maintain bank integrity to prevent erosion during high flows. 3. Maintain bank integrity to prevent erosion during high flows. 4. Prevent sediment delivery to stream and prevention of concentration of overland flow. 5. Maintain and improve fish habitat complexity by recruitment of large wood material.	Silver Fire Summary Kormeier, 1995, Biscuit Erosion Pin Study 2005, Water Thin Fuels Treatment Erosion Study 2006 Silver Fire Summary Kormeier, Water Thin Fuels treatment erosion study 2006 Evaluation of Non-Point Silviculture Sources, EPA 1980

Northwest Forest Plan Temperature TMDL Implementation Strategies

The following table establishes the distance (feet) from the active stream channel where no removal (thinning) of the overstory canopy will occur to protect stream shade on perennial streams.

Table 2. Minimum Width of Primary Shade Zone (feet) based on Hill Slope and Tree Height[3]

TREE HEIGHT	HILL SLOPE <30%	HILL SLOPE 30% TO 60%	HILL SLOPE >60%
Trees < 20 feet	12	14	15
Trees 20 to 60 feet	28	33	55
Trees >60 to 100 feet	50	55	60
Trees >100 to 140 feet	70	75	85

The Temperature Implementation Strategies allows the distances in Table 2 to be less if one of the following conditions applies:

1. The trees are located on a south facing slope and therefore do not provide stream shade
2. An appropriate level of analysis is completed and documented, such as shade modeling, using site specific characteristics to determine the primary shade tree width
3. Field monitoring or measurements are completed to determine the width where optimum Angular Canopy Density (65% or greater) is achieved

NOTE

- Within the primary shade zone:
  - Trees may be limbed;
  - Understory may be thinned and removed or hand piled and burned;
  - Overstory may be thinned on south facing aspects only.

Literature Cited

Corbett, E.S. and J.A. Lynch. 1985. Management of Streamside Zones on Municipal Watersheds. Pp. 187-190. First North American Riparian Conference, April 16-18. 1985, Tucson, Arizona.

[3]The approximate width of the primary shade zone and thus any treatment thereof should consider stream orientation, sinuosity, aspect, bank and channel stability, channel migration, channel width and potential for sediment loading.

EPA 1980. An Approach to Water Resources Evaluation of Non-Point Silviculture Sources: EPA 600/8/80/012.
Kormeier, E. 1995. Summary of Fish Habitat/Water Quality Since the Silver Fire of 1987. Siskiyou National Forest, Grants Pass, Oregon
Lynch, J.A., E.S. Corbett, and K. Mussallem. 1985. Best Management Practices for Controlling Non-point-Source Pollution on Forested Watersheds. J. Soil and Water Conservation 40:164-167.
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USFS, DEQ, and BLM, 2005. Northwest Forest Plan Temperature TMDL Implementation Strategies, Pacific Northwest.